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MONTANA AIR POLLUTION STUDY

Computer Information System Development

November, 1979

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Front Cover illustration is based on a drawing by Leonardo da Vinci that has come to symbolize human health.

COMPUTER INFORMATION SYSTEM DEVELOPMENT

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MONTANA AIR POLLUTION STUDY

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PREFACE

This is one of a series of technical reports presenting results from the Montana Air Pollution Study (MAPS), a special air monitoring and health effects project of the Air Quality Bureau, Montana Department of Health and Environmental Sciences. The 1977 Montana Legislature provided the MAPS project with $1.07 million for the 1977-79 biennium in order to improve understanding of how air pollution affects health in Montana.

The various MAPS activities have been grouped into five major categories for purposes of project management: Health Effects; Air Quality; Meteorology/Modeling; Emission Inventory; and Statistics and Data Systems. Results from each of these technical areas are being presented in one or more technical reports prepared by the personnel directly involved in the study efforts. There will also be a technical summary report and a report to the public in layman's language.

This specific report, in the Statistics and Data Systems area, presents a description of the MAPS activities related to computerized data processing system development. It includes a brief description of the overall information processing system, more detailed descriptions of the major sub-systems in place and in use, and a discussion of further enhancements that would be desirable. This report was prepared by David A. Lynn, MAPS Technical Manager, based on system development efforts by James W. Gelhaus and Michael D. Roach of the Air Quality Bureau, and by Thomas Stewart, David Orndoff, Patricia Shevalier and Angie Leprohon, systems consultants under contract to the Bureau.

TABLE OF CONTENTS

Page

PREFACE i

EXECUTIVE SUMMARY ii

I. INTRODUCTION 1

II. DESIGN AND IMPLEMENTATION 4

III. THE PFT DATA SYSTEM 9

INTRODUCTION 9
FILES AND PROGRAMS 10
PRODUCTION JOBS 17
USE OF THE SYSTEM 18
DATA ARCHIVES 25

IV. THE AIR QUALITY/METEOROLOGY DATA SYSTEM 26

INTRODUCTION 26
DATA FILES AND CODING STRUCTURES 34
COMPUTER PROGRAMS 39
PRODUCTION JOBS 40
USE OF THE SYSTEM 43

V. OTHER SUBSYSTEMS 60

VI. FURTHER WORK 62

APPENDIX A: PFT DATA CODING FORMS 65
B: AIR QUALITY BUREAU DATA FILES 83
C: STANDARD SAROAD CODES 89
D: SAROAD CODING FORMS 93

EXECUTIVE SUMMARY

Under the auspices of the MAPS program, a systems development effort was undertaken to expand the Air Quality Bureau's limited data processing capabilities into a comprehensive computerized information system. Initial conceptual analysis was completed, and data processing systems were developed and installed to meet higher-priority requirements. These requirements were the processing of pulmonary function testing (PFT) data from the MAPS health effects studies (a new system was developed), the development of a data bank for air quality and meteorology data (an EPA system was installed and modified), and the Air Resources Modeling System (EPA models were installed and adapted). Other lower-priority needs were not undertaken and remain to be done, as do further enhancements of the data bank and modeling systems.

This report briefly outlines the activities undertaken and includes introductory summaries of the PFT and data bank systems.

I. INTRODUCTION

This report summarizes activities under the Montana Air Pollution Study (MAPS) in developing computerized data systems. Several of the goals and objectives of the MAPS project involved the development of new or improved systems for processing data gathered, or making better use of available data from existing Air Quality Bureau activities. The various project components and their inter-relationship are illustrated in Figure 1; primary computer system efforts are the Data Bank, the Air Resources Modeling System (ARMS), the Comprehensive Computer Information System, and other smaller components.

The Data Bank was planned as a necessary storage and retrieval facility for all data flowing through the Air Quality Bureau (AQB). The MAPS project generated data in volumes several times those previously handled by the Bureau's already-strained processing system so a more automated, higher-capacity system was required. Because the data load from MAPS would dominate the system, and also because it is highly inefficient to maintain two systems, the planned MAPS system was intended to take over the processing of other non-MAPS data as well. These data included those from various meteorological studies, data gathered by private sources, and air quality data gathered at other AQB monitoring sites. Consequently, the project also called for the thorough integration of non-computer, or people, functions in the data processing system.

The Air Resources Modeling System (ARMS) is a specific objective of the

MAPS project; modeling involves the estimating of ambient air pollution concentrations using pollutant emission and meteorology data. The lack of adequate modeling capability, caused by Montana's complex terrain and an insufficient base of meteorological data, has been a serious handicap in Bureau decision-making. Through the development of the ARMS system and the gathering of adequate meteorological data, the improvement of this capability was a major MAPS objective. The development of the ARMS modeling system is described in a separate MAPS technical report, Montana Air Resources Modeling System, by J. W. Gelhaus *et al.*

The Comprehensive Computer Information System, indicated in Figure 1 as encompassing the Data Bank and ARMS components, is an objective meant to encompass all the data flow and decision-making functions of the Bureau. Whenever there are large quantities of various types of data or information being used for various purposes by various people, there is a potential for identifying frequent data uses and computerizing them. Significant savings can usually be found in an organization using as many types of data as does the Air Quality Bureau; however, the specific details of any such system cannot be well defined in advance. Therefore, in the process of automating the MAPS data processing, it was decided to conduct a thorough needs survey of every Bureau function.

This report summarizes the activities that have been conducted toward these objectives, describes the data systems that have resulted, and indicates in some cases the further efforts that are required.

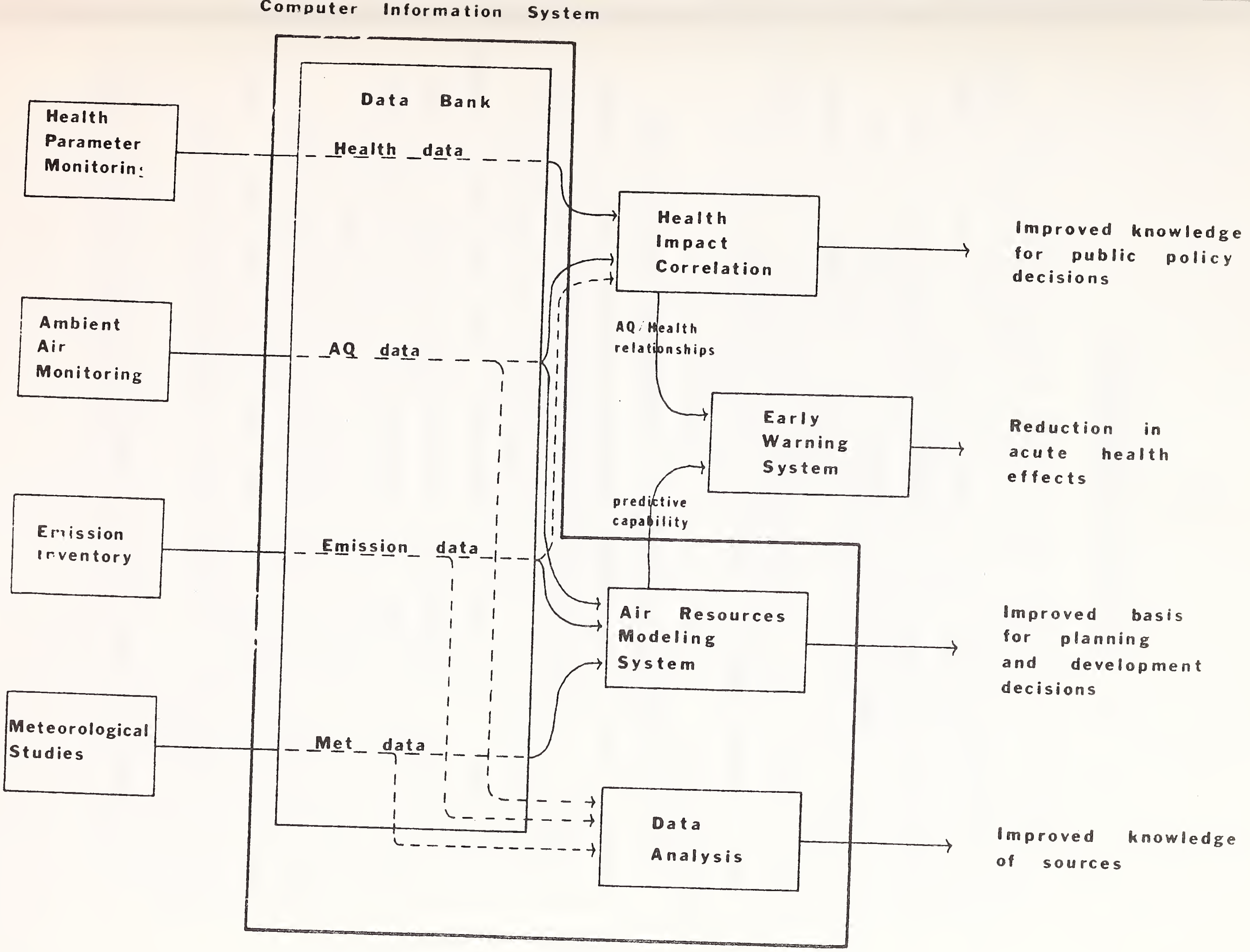

Computer Information System
Data Bank
Health Parameter Monitoring
Ambient Air Monitoring
Emission Inventory
Meteorological Studies
Health data
AQ data
Emission data
Met data
Health Impact Correlation
AQ/Health relationships
Early Warning System
predictive capability
Air Resources Modeling System
Data Analysis
Improved knowledge for public policy decisions
Reduction in acute health effects
Improved basis for planning and development decisions
Improved knowledge of sources

Figure 1 - MAPS Project Components

II. DESIGN AND IMPLEMENTATION

The term "system" has many uses in systems analysis contexts, but it always carries a basic concept that the various elements of the system, whether they are computer programs, pieces of programs, groups of programs, or various associated human functions, must be considered in conjunction with all the other various elements, rather than in isolation. In line with this basic premise, the appropriate first step in considering a comprehensive information system for MAPS and other Bureau activities is to review the overall functions of the Bureau, the interactions among its parts, and the information flows that these imply.

This initial overall investigation was conducted by the staff of the Information Systems Division (ISD) of the State Department of Administration, on request of the Bureau. ISD personnel identified a number of difficulties in Bureau data communications that would be magnified by the increased data flow from MAPS, and identified some additional functions that might be improved by computerization. However, most of these had been anticipated in the MAPS design, so the primary result of the ISD effort was to assist the MAPS staff in accurately defining the boundaries among the various components; this enabled development to be initiated on the highest priority needs without concern about foreclosing options on the lower priority needs that would have to await implementation. The major elements identified by the ISD review are listed in Table 1.

The schedule under which ISD could undertake any systems development work,

TABLE 1

Functional Elements in Overall
AQB Information System

1.0 Provide a Comprehensive Data Base

- 1.1 Expand current capability for air quality data processing
  - 1.1.1 Interface with data logging equipment
  - 1.1.2 Intergrade non-AQB data
- 1.2 Expand current capability for meteorology data processing
  - 1.1.1 Interface with data logging equipment
- 1.3 Expand capability of emission data processing system
- 1.4 Automate processing of health effects data
  - 1.4.1 Mortality data
  - 1.4.2 Pulmonary function data
  - 1.4.3 Mutagen screening data
- 1.5 Automate processing of topographic data
- 1.6 Automate processing of standards and effects data
  - 1.6.1 Morbidity data
- 1.7 Automate processing of enforcement data

2.0 Provide Capabilities for Projections and Data Analysis

- 2.1 Expand current modeling capabilities
- 2.2 Develop the Air Resources Modeling System
- 2.3 Automate statistical analysis procedures

3.0 Automate the Bureau Library Facilities however, was inadequate to meet the time requirements of MAPS, so it was necessary to seek a private systems firm to undertake the work under contract. The work was subsequently contracted to Montana Computer Consulting of Helena.

The highest priority systems component was the provision of basic data bank capabilities for the processing, storing, and retrieving of the various types of data. The existence of such a data bank to replace the Bureau's existing semi-computerized data system was mandatory if the increased volume of MAPS air quality and meteorology data, and the totally-new health effects data, were not to overwhelm the existing staff. Furthermore, if all data were placed and kept in an accessible computerized repository, conveniently available to anyone requiring it, most data communication problems among the various AQB setions would be eliminated. This is in fact a good operational definition of data bank - a system such that the data users can access the data at will without becoming involved in the data gathering and storing functions, which proceed independently.

It was decided early in the systems planning that the most economical way to provide data bank capabilities for air quality data was to adopt and to install on the state computer system a data-processing system known as the "Air Quality Data Handling Sub-system" (AQDHS) of the "Comprehensive Data Handling System" (CDHS). This system was developed by the Environmental Protection Agency (EPA) specifically for use by state air quality agencies. It is a natural extension of the Bureau's existing procedures, which already use the same pollutant and sampling site coding structures. However, the AQDHS system made very minimal provision for any meteorological data, and no provision for data such as the health effects group's pulmonary function testing results. The plan called for the immediate installation of the EPA-provided programs, followed by subsequent modification to provide a system tailored to local needs.

Given the required time schedule and the available options, it was also decided to incorporate the meteorology data into the AQDHS system and to provide a largely separate system to handle the pulmonary function testing (PFT) data. The meteorology data, like air quality data, have continuous on-going usefulness and are fundamentally structured about specific geographical sites and specific points in time. In contrast, the PFT data are fundamentally structured about individual human subjects, and have, at least with current plans, relatively little use as raw data once the MAPS special project is completed.

The interim meteorology data processing required not only the expansion of the AQDHS coding structure to incorporate the additional parameters, but also a series of pre-processor programs. These latter were needed because, unlike the air quality sensors, most of the meteorological instruments do not produce the final numerical data directly, but rather require some calculation or other manipulation of the raw data to produce the desired final values.

The PFT data processing system was designed to meet the immediate needs of the MAPS health effects study by processing the data and making them available for analysis. The PFT system also provides for an interface with the air quality and meteorology data bank, because the AQDHS system retrievals do not readily provide the interface necessary for analysis of the air quality and PFT data together.

As noted earlier, the contract for system development envisioned the immediate installation of the AQDHS system, with only the tailoring necessary to make it acceptably functional. Thereafter, when staff members had some experience with the system, and the systems analysts had the opportunity to become more familiar with the Bureau's needs, additional modifications would be incorporated to provide a system thoroughly tailored to the local Montana requirements. Because of time restriction, this latter goal was not achieved during MAPS' first two years of operation. In the process of converting the historical data accumulated by the Bureau into the AQDHS master file format, a large quantity of errors was discovered, the result of AQDHS editing data which had been processed without editing under the previous system. As a result of having to correct these errors, and simply from the sheer volume of data not previously stored, the process of converting historical data required much more time and resources than had been anticipated. Consequently, the thorough user needs survey and system optimization could not be completed within the time and resources available.

The next two sections of this report describe the PFT and AQDHS systems as they were developed. The intent is only to orient an interested reader or potential user to the overall structure and use of the systems; more detailed documentation is available and should be consulted when actually using the system.

III. THE PFT DATA SYSTEM

The health effects portion of the MAPS project adopted as one of its major efforts a program of monitoring pulmonary function, or lung performance, parameters as a possible indicator of air quality impacts on health. The pulmonary function testing (PFT) program generated sizable quantities of structured data, and the system described in this section was developed to process and store these PFT data. This system was designed and developed by David K. Orndoff and Angie Leprohon of Montana Computer Consulting.

Introduction

The pulmonary function testing program involved two major populations of subjects that were monitored on a systematic basis. A population of adults suffering from chronic obstructive pulmonary disease (the COPD patients) was monitored on a longitudinal basis, i.e., month by month over a period of time, to investigate the existence of short-term acute effects of air pollution. The second population consisted of elementary school children; one group of children was monitored on a longitudinal basis to investigate acute effects, while a separate group of children was monitored on a cross-sectional basis to provide a comparison among the several MAPS study cities. Because the information gathered on the two groups of school children was identical, it is treated together in the data system.

The school children PFT study generated data of two types - background information on each child, gathered by questionnaire (Form 1) and the data recorded at the time of testing each month (Form 2). The COPD patient study also generated a background questionnaire (Form 3) and monthly data (Form 4);

in addition, the COPD patients kept daily diary records prior to their monthly tests (Form 5). Copies of these forms are included as Appendix A of this report.

In contrast to the air quality and meteorology data, which are fundamentally linked to a specific geographic location, the PFT data are primarily linked to specific human subjects. Consequently, the overall system review suggested that it would be most unlikely that any data processing system developed to handle the current raw data would be able to integrate smoothly with any future health effects record system that might be devised. Rather, any such future system would probably be oriented toward geographical location and would involve geographical summaries of health effects data. The present PFT data can be viewed in this way, i.e., measurement on the population of children at a specific school can be viewed as monitoring the health impacts on the neighborhood represented by the school. In fact, the cross-sectional comparison among cities depends on exactly this logic. However, any future data system would require location-oriented summaries, rather than child-oriented raw data, and was judged to be fairly unlikely at best.

Consequently, the PFT data system was designed separately from the major data bank system, except for the final retrieval file, which is designed to interface the PFT data with appropriate air quality parameters for analysis. The system was designed for the logistics of the testing program as currently conducted, recognizing that any subsequent use would perhaps require modification.

Files and Programs

The PFT system consists of five defined data files maintained on magnetic tape and four computer programs, which are combined to accomplish a number of specific tasks or jobs. The five data files are:

F05.T608.M01 - Background File. This contains data from background questionnaires for both school children and COPD patient groups.

F05.T608.M02 - School Children Historical Data Files. This contains monthly data from Form 2 and the test data; in addition, the child's background data from file M01 is appended to each record.

F05.T608.M03 - COPD Historical Data File. This contains monthly data from Form 4 and the test data; in addition, the patient's background data from file M01 is appended to each record.

F05.T608.M04 - COPD Daily Report File. This contains data from the patients' daily diary forms (Form 5); in addition, the patient's background data from file M01 is appended to each record.

F05.T608.M05 - Matrix File. This file contains data from file M02, 3, or 4 as required, including the appended background data, and in addition, has appended to each record certain air quality and meteorological parameters; it is intended primarily for analysis purposes.

These five files are accessible to any user program, such as SPSS or similar statistical analysis packages. Files M01 through M04 are permanently maintained on the system, while file M05 is usually generated specifically for each use. Files M01 through M04 are maintained as Generation Data Sets (GDS); that is, several versions are kept, so that the most current and several recent updates are all available in case there is a problem with an update run. The current version is available to a user by coding DSN=F05.T608.M0x(0),UNIT=TAPE, DISP=(OLD,KEEP) in the required data definition (DD) statement. The record formats of the permanent files are provided in Tables 2 through 6. For details of the data itself, refer to the data forms in Appendix A.

Note that File M01 contains the background questionnaire data for both school children and COPD patients, distinguished by the Form code in position 1; File M01 also constitutes a master list of study subjects, and is so used by the update programs. Files M02, M03, and M04 contain the children's test data, the COPD patient's data, and the patient's diary data, respectively.

TABLE 2

Record Format - File F05.T608.M01

Background File

Positions	Field Descriptions
1	Form number (1 or 3)
2-5	Subject ID number
6-17	Subject last name
18-25	Subject first name
26	Subject initial
(If position 1=1)	
27-28	School Code
29	Grade
30-35	Birthdate (Mo/Day/Yr)
36	Sex Code
37	Race Code
38-112	Numeric data from positions 38-112 of Form 1
113	Frequency code (Monthly, Seasonal, Annual)
114	Update code (add or change)
115-150	Filler - not used
(If position 1=3)	
27-32	Birthdate (Mo/Day/Yr)
33	Sex
34-136	Numeric data from positions 34-136 of Form 3
137	Update code
138-150	Filler - not used

Note: Generation Data Set - 3 entries
Block size 12900 = 86 records of 150

TABLE 3

Record Format - File F05.T608.M02
School Children Historical File

Positions	Field Description
1	Form number (2)
2-5	Child ID number
6-11	Test date (Mo/Day/yr)
12-15	Test period (Mo/Yr)
16	Season Code
17-18	School Code
19-34	Numeric data from positions 19-34 on Form 2
35-50	Filler - Not used
51-65	Best PF test data - 5 values of 3 positions each (FVC, FEV$_{.75}$, FEV$_{1.0}$, PEFR, FEF in order)
66-80	Second best test data - five values as in 51-65
81-110	Temperature-corrected test data - 10 values as in 51-80
111	Form Number (1)
112-224	Numeric data from positions 2-114 of Form 1 (or File M01)
225-240	Filler - not used

Note: Generation Data Set - 3 entries
Block size 12960 = 54 records of 240

TABLE 4

Record Format - File F05.T608.M03
COPD Historical Data File

Positions	Field Description
1	Form number (4)
2-5	Patient ID number
6-11	Test Date (Mo/Day/Yr)
12-15	Test Period (Mo/Yr)
16-61	Numeric Data from positions 16-61 of Form 4)
62-70	Filler - not used
71-85	Best PF test - 5 values as in Table 3
86-100	Second best test - 5 values
101-130	Temperature-corrected test data - 10 values
131	Form number (3)
132-267	Numeric data from positions 2-137 of Form 3 (or File M01)
267-280	Filler - not used

Note: Generation data set - 4 entries
Block size 12880 = 46 records of 280

TABLE 5

Record Format - File F05.T608.M04
COPD Daily Report File

Positions	Field Description
1	Form number (5)
2-5	Patient ID number
6-11	Report Date (Mo/Day/Yr)
12-30	Numeric data from positions 12-30 of Form 5
31-50	Filler - not used
51	Form number (3)
52-187	Numeric data from positions 2-137 of Form 3 (or File M01)
188-200	Filler - not used

Note: Generation data set - 4 entries
Block size - 13000 = 65 records of 200

TABLE 6

Record Format - File F05.T608.M05
Matrix File

Positions	Field Description
1	Form number (2,4, or 5)
2-5	Subject ID number
6-11	Test date (Form 2,4) or report date (Form 5)
12-280	Remainder of pulmonary function record Form 2: 12-224 numeric data 225-280 filler Form 4: 12-267 numeric data 268-280 filler Form 5: 12-187 numeric data 188-280 filler
281-430	Air quality and meteorology data - 30 fields in XXXXD form

Field	Parameter	Parameter Code
281-285	TSP	11101
286-290	Arsenic	12103
291-295	Cadmium	12110
296-300	Lead	12128
301-305	Zinc	12167
306-310	Sulfates	12403
311-315	Beta Inst.-fine	31130
316-320	Sulfur dioxide	42401
321-236	Nephelometer	11203
306-330	UV radiation	63302
331-335	Ozone	44201
336-340	Nitrogen oxides	42603
341-345	Nitrogen dioxide	42602
346-350	Carbon monoxide	42101
351-355	Wind speed	61101
356-360	Wind direction	61102
361-365	Temperature	62101
366-370	Relative humidity	62201
371-375	Total hydrocarbons	43101
376-380	Solar radiation	63301
381-385	Expansion	
386-390	Dichotomous (total)	31140
391-395	Dichotomous (fine)	31120
396-400	Dichotomous (coarse)	31121
401-405	Broadleaf pollen	33001
405-410	Conifer pollen	33002
411-415	Grass pollen	33303
416-420	Weeds pollen	33004
421-425	Total pollens	33005
426-430	Total spores	33006

Each of these three files has the appropriate background data appended to each record for ease in analyzing the influence of background variables on the test values. File M05, the matrix file, consists of a copy of either File M02, 3 or 4, with appropriate air quality and meteorology data appended to each days's record; the matrix file is the common interface between the PFT and the main data bank systems.

There are four computer programs that constitute the PFT data system, described here briefly for record pruposes; more detailed program definition and description are available in the System Documentation Manual maintained both in the Bureau and the computer center. In general, user access to the system will be via several standard production jobs, described subsequently, rather than via these individual programs.

Program MC3490 - Update/List Background Data File. This program maintains the M01 background file. It accepts a data entry file of Form 1 and Form 3 records and adds, corrects, or deletes records from the file. It can list the background file in a variety of sequences, in conjunction with an update or separately.

Program MC3491 - Update School Children Historical File. This program maintains the M02 children's data file. It accepts Form 2 records from a data entry file to update the file with current data, add late data, or correct previously added data. It edits the incoming data and uses the M01 background file to assure that a record exists for each child for each test period.

Program MC3492 - Update COPD Historical File. This program maintains both the M03 COPD data file and the M04 daily report file. It accepts Form 4 and 5 records from a data entry file, sorts and edits them, and adds or corrects data on the files.

Program MC3516 - Generate Matrix File. This program generates the matrix file F05.T608.M05, combining PFT and air quality data. The program requires a card deck containing instructions on options and information permitting it to match various schools with various air monitoring sites. It accepts a PFT data tape and an AQDHS tape, and matches the latter to the former in accordance with instructions.

Production Jobs

The routine normal use of the data system by PFT program personnel to process their data is via predefined production jobs. Using the above programs and data files on the computer center's IBM 370 system requires a knowledge of IBM's Job Control Language (JCL) and familiarity with the center's data entry equipment and job handling procedures. To minimize the burden this would otherwise place on users, the Computer Services Division maintains a system of pre-defined production jobs and supplies personnel (I/O Controllers) to handle the jobs. The PFT data system includes five such production jobs.

J05608A - Update Background File

J05608B - List Background File

J05608C - Update School Children Historical File

J05608D - Update COPD Historical Files

J05608E - Generate Matrix File

Each of these production jobs has a cataloged procedure (PROC) stored on the computer library disk containing the JCL instructions required to identify the various files and invoke the proper programs(s) needed by the computer part of each job. Each job also has instructions on file at the computer center for the I/O controller (on Form #60, Production Work Order), for the Data Entry Section (on Form #9, Data Entry Instructions) and for the computer room operators (on Form #20, Job Operating Instructions). Copies of the cataloged procedures and the various instruction forms are included in the System Documentation Manual.

Use of the System

The PFT system is used for data input and file maintenance, and also for data retrieval, both for data validation and later for data analysis. Production jobs J05608A through D are used by the person responsible for gathering and entering the data; this has been the PFT coordinator in Missoula. Job J05608E is used primarily for creating retrieval tapes for data analysis, and

FIGURE 2

DATA PROCESSING REQUEST FORM

DATA PROCESSING DIVISION
JULY 24, 1972 FORM #5

REQ. AGENCY	Montana Air Pollution Study	DATE		FORM # 5 NUMBER	1

JOB NUMBER	J05608A	JOB NAME	Update Background File

REQ. BY		REQ. COMP. DATE		PHONE NUMBER	

PROCESSING REQUESTED

Run Job J05608A According to Work Order W05608A.

ITEMS SUBMITTED

1. ______ MAPS Forms 1
2. ______ MAPS Forms 3
3. ______ List Sequence Code (see below)
4. ______ Line Format (L=Long format, S= Short format
5. ______ Number of copies of ptined output

SPECIAL INSTRUCTIONS

List Sequences

01-ID Number
02-School Code by ID Number
03-Last Name
04-School Code by Last Name
05-School Code by grade by ID #
06-School Code by grade by name
07-Grade by ID #
08-Grade by last name
99-No List

REMAINDER TO BE COMPLETED BY BUREAU

DATA CONTROLLER ASSIGNED		DATE		DATE COMPL.	

FIGURE 3

DATA PROCESSING REQUEST FORM

DATA PROCESSING DIVISION
JULY 24, 1972 FORM #5

REQ. AGENCY	Montana Air Pollution Study	DATE		FORM # 5 NUMBER	2

JOB NUMBER	J05608B	JOB NAME	List Background File

REQ. BY		REQ. COMP. DATE		PHONE NUMBER	

PROCESSING REQUESTED

Run Job J05608B according to Work Order W05608B

ITEMS SUBMITTED

1. ______ List Sequence Code (see below)
2. ______ Number of copies of printed output
3. ______ Line format (L= long format, S= short format)

SPECIAL INSTRUCTIONS

List Sequences

01-ID Number
02-School Code by ID Number
03-Last name
04-School code by last name
05-School Code by grade by ID #
06-School Code by grade by name
07-Grade by ID #
08-Grade by last name
99-No list

REMAINDER TO BE COMPLETED BY BUREAU

DATA CONTROLLER ASSIGNED		DATE		DATE COMPL.	

FIGURE 4

DATA PROCESSING REQUEST FORM

DATA PROCESSING DIVISION
JULY 24, 1972 FORM #5

REQ. AGENCY	Montana Air Pollution Study	DATE		FORM # 5 NUMBER	3

JOB NUMBER	J05608C	JOB NAME	Update School Children Historical File

REQ. BY		REQ. COMP. DATE		PHONE NUMBER	

PROCESSING REQUESTED

Run Job J05608C according to Work Order W05608C.

ITEMS SUBMITTED

1. ______ MAPS Forms 2
2. ______ Period (month/year)
3. ______ Season (1-4)
4. ______ Standard Deviation Multiplication Factor (1.0 default)
5. ______ Number of copies of printed output

SPECIAL INSTRUCTIONS

REMAINDER TO BE COMPLETED BY BUREAU

DATA CONTROLLER ASSIGNED		DATE		DATE COMPL.	

FIGURE 5

DATA PROCESSING REQUEST FORM

DATA PROCESSING DIVISION
JULY 24, 1972 FORM #5

REQ. AGENCY	Montana Air Pollution Study	DATE		FORM # 5 NUMBER	4

JOB NUMBER	J05608D	JOB NAME	Update COPD Historical File

REQ. BY		REQ. COMP. DATE		PHONE NUMBER	

PROCESSING REQUESTED

Run Job J05608D according to Work Order W05608D.

ITEMS SUBMITTED

1. ______ MAPS Forms 4
2. ______ MAPS Forms 5
3. ______ Test Period (Month/year)
4. ______ Standard Deviation Multiplication Factor (1.0 default)
5. ______ Number of Copies of printed output

SPECIAL INSTRUCTIONS

REMAINDER TO BE COMPLETED BY BUREAU

DATA CONTROLLER ASSIGNED		DATE		DATE COMPL.	

has been run primarily by the systems analysts who developed the system and by the AQB personnel. (The use of the matrix file job is complex and has not been made routine as of this writing.)

To request the execution of any of the production jobs, a request is submitted to the Data Processing Division on their Form 5; standard partially-completed Form 5's for jobs J05608A through D are shown in Figures 2 through 5. Job A is used to build, correct and examine the background file until the list of subjects is complete and accurate. If new subjects enter the study late, they are added using Job A; then subsequent uses of other jobs would include them in the other data files, since the Background File (M01) is used as a master subject list. Job B, which provides only a list of the background file, is used by the testing staff to provide at the beginning of each month a list of the subjects to be tested; this helps assure that a test Form 2 is prepared each month for each subject, and thus minimizes subsequent corrections.

Jobs J05608C and D are run monthly or periodically to update the data files. The coded and checked monthly data forms are submitted to the Data Processing Division with the appropriate Form 5's, and the data entry and computer runs are overseen by the assigned I/O controller, who returns the requested printouts for checking. If corrections are required, the PFT staff may submit them separately with a Form 5, or may include them with the next batch of data to be updated. The data processing system does not itself require that data be submitted monthly, or in any other particular fashion; however, submitting the data in an orderly organized fashion is desirable in order to follow closely the status of various batches of data and release them for analysis as requested.

Job J05608E, creating a matrix file, is not as simple or routine as the others, since it requires some steps involving the main AQDHS data bank system.

Currently (fall 1979), this job is handled by the AQB staff who also handle the AQDHS system. (The data bank system, as will be described in the next section, is not organized to be run by the computer center I/O controllers).

The matrix file format and associated program are designed so that a complete permanent file can be maintained for analysis. However, to date such files have been created only for transmitting data to out-of-town analysts who do not have access to the Helena computer center. These data analysts have chosen to rearrange the file structure to suit their computers and their preferences; hence the capabilities and usefulness of the matrix file structure have not been truly utilized and evaluated. When all the air quality and meteorology data to be available are properly stored in the data bank, a permanent matrix file can be created and maintained.

One of the features of the matrix file is that it can be utilized in different ways depending on how the air quality monitoring sites are matched with the children's schools. The system has the capability of matching any valid monitoring site code with any school code in the PFT study. This can be routinely used to associate Butte air quality data with Butte schools, and so forth; however, this capability has not been used extensively, because analysis of the inter-city and cross-sectional study requires only long-term air quality averages rather than day-by-day data. The same school-matching ability can also be used to associate various schools in a city with various monitoring sites, assuming there is more than one site in the city. For the monthly longitudinal study of acute effects in Missoula, which makes heavy use of air quality data, a variety of complexities has been encountered. For some parameters, such as TSP and wind speed, data from multiple sites are available; for others, indeed most, data from only one site are available. Hence a matrix file can be created in a variety of ways according to the desires of a specific data analyst for a particular purpose. Experience to date with users requesting matrix file summaries has been uneven, because of these complexities and the users' uncertainties as to their needs. To reduce these difficulties, a special in-house AQB request form is being developed for this use.

Data Archives

Based on the results of initial analyses of the first two years' studies, the PFT program modified its operational plans for the 1979-80 school year. The COPD patient study was discontinued, and the school children study was modified. The consequent demands on the data system are enough different that it has been desirable to archive separately the data files assembled during the first two years, and begin again with operations in the fall of 1979. Access to the archived data for the first two years will be maintained by the AQB Data Coordinator, as is described separately.

IV. AIR QUALITY AND METEOROLOGY DATA SYSTEM

Introduction

In the normal functioning of an air pollution agency, it is necessary to collect, catalog, sort, evaluate and analyze quantities of data on ambient air quality and meteorological conditions. This was true of the Montana Air Quality Bureau prior to the undertaking of the MAPS program, and the major effects of MAPS were to increase greatly the quantity of data to be processed and to extend the requirements for analyzing the data to meet MAPS objectives.

As has been mentioned previously, the data system development effort first undertook an overall system review of AQB functions. This indicated a number of problems associated with data flow in the Bureau, but none that were not already well-known. It also indicated that a system handling only air quality and meteorological data could be implemented without harmfully foreclosing future options with respect to other types of data.

Consequently, it was decided to proceed with the installation of the Air Quality Data Handling Subsystem (AQDHS-II) available from EPA, and to augment it to handle the necessary meteorological data. The AQDHS-II system installation was done by Pat Shevalier, and the meteorological pre-processing programs were written by Tom Stewart. As time was critical, it was decided to install the system with a minimum of modification, and then to return to a more thorough analysis of detailed requirements and more precise customization to AQB needs. The Bureau obtained the system from EPA as a series of programs on magnetic tape and installed it on the Department of Administration's IBM 370 computer system in Helena. This was done with a minimum of difficulties, except for the last step of transferring the existing data accumulation into the new data bank. For a variety of minor reasons, this took a great deal more time and effort than had been anticipated.

In order to maximize efficient use of both the new computer system and the data collected, a concurrent attempt was begun to optimize the overall data processing efforts within the Bureau. The initial task was to identify and document the flow of all air quality and meteorological data through the Bureau. Using the results of this investigation, manual data handling procedures could then be modified and/or simplified, and some personnel's job functions could be clarified or changed, along with likely modification of the computer system. One of the most important initial results of this optimization effort was the identification of the need for a specific person or position within the Bureau to have clear-cut, overall responsibility for maintaining the flow of data into and through the Bureau.

Prior to implementation of the new AQDHS system, the Air Quality Bureau did not have a comprehensive procedure for the computer processing of all collected ambient air quality and meteorological data. As the air monitoring network expanded, more individuals had become involved in the processing of the data, and no single person was responsible for overseeing all aspects of data handling. It was strongly recommended that a single person, a Data Processing Controller, be made responsible for the flow of all data from the time they are received in the Bureau from the field operators, through being stored on the computer system, until they are provided to requestors in a usable format. The Data Processing Controller position was established within the Bureau's Technical Services section to work in conjunction with one or more statistical technicians and to be the primary liason between the

Bureau and Computer Services Division.

A detailed data flow diagram was prepared to portray a partly-optimized version of the overall data flow. This diagram (Figure 6) includes all the steps required, both manual and automated, in the processing of each data type and summarizes the various functions of the Data Processing Controller position. Since the implementation of this data flow is still imcomplete, it remains a goal and is presented here primarily to illustrate the complexity of the data handling process. A step-by-step discussion of the current procedures is presented in Appendix B.

Figure 6a
Data Flow - Steps 1-4

Figure 6

AIR QUALITY AND METEOROLOGICAL DATA FLOW

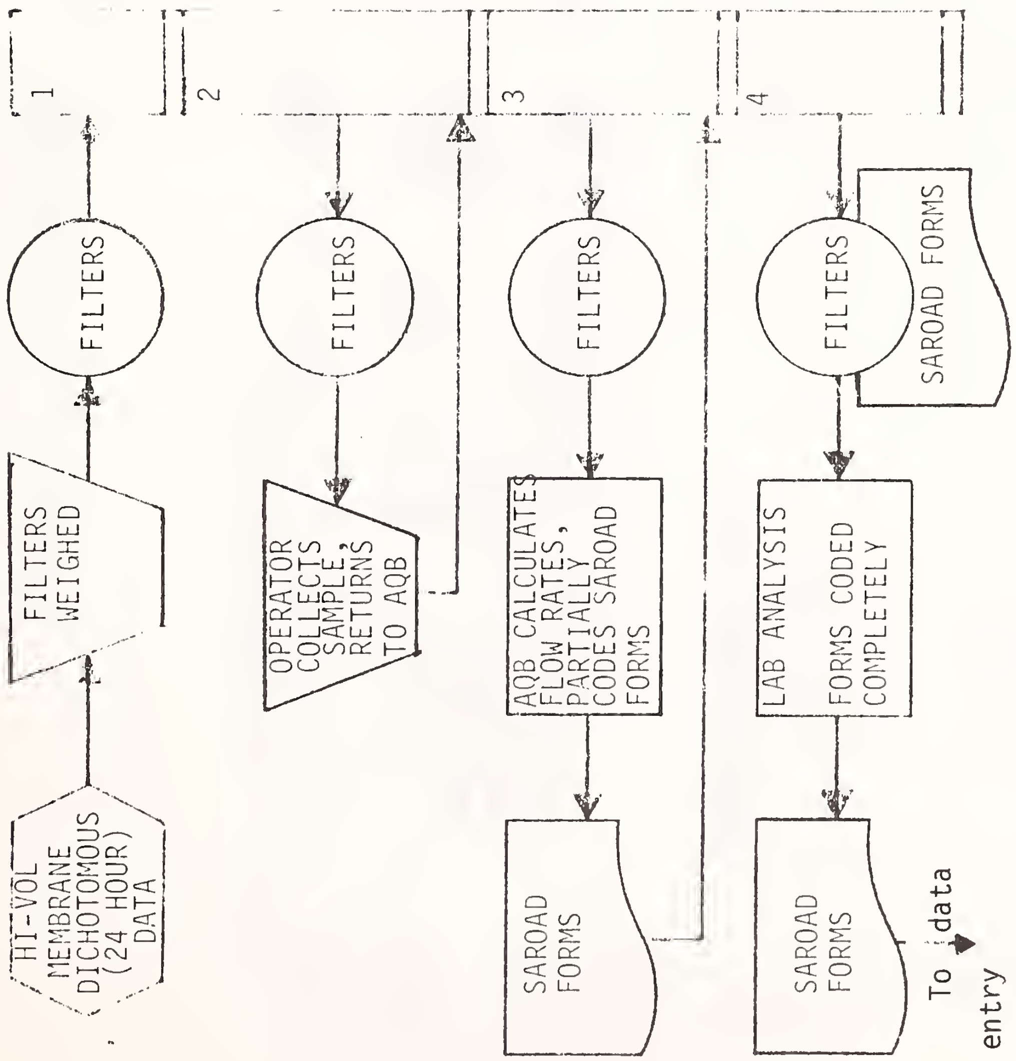

1
2
3
4
HI-VOL MEMBRANE DICHOTOMOUS (24 HOUR) DATA
FILTERS WEIGHED
FILTERS
OPERATOR COLLECTS SAMPLE, RETURNS TO AQB
FILTERS
AQB CALCULATES FLOW RATES, PARTIALLY CODES SAROAD FORMS
FILTERS
SAROAD FORMS
LAB ANALYSIS
FORMS CODED COMPLETELY
FILTERS
SAROAD FORMS
SAROAD FORMS
To data entry

Figure 6b
Data Flow - Steps 5-7

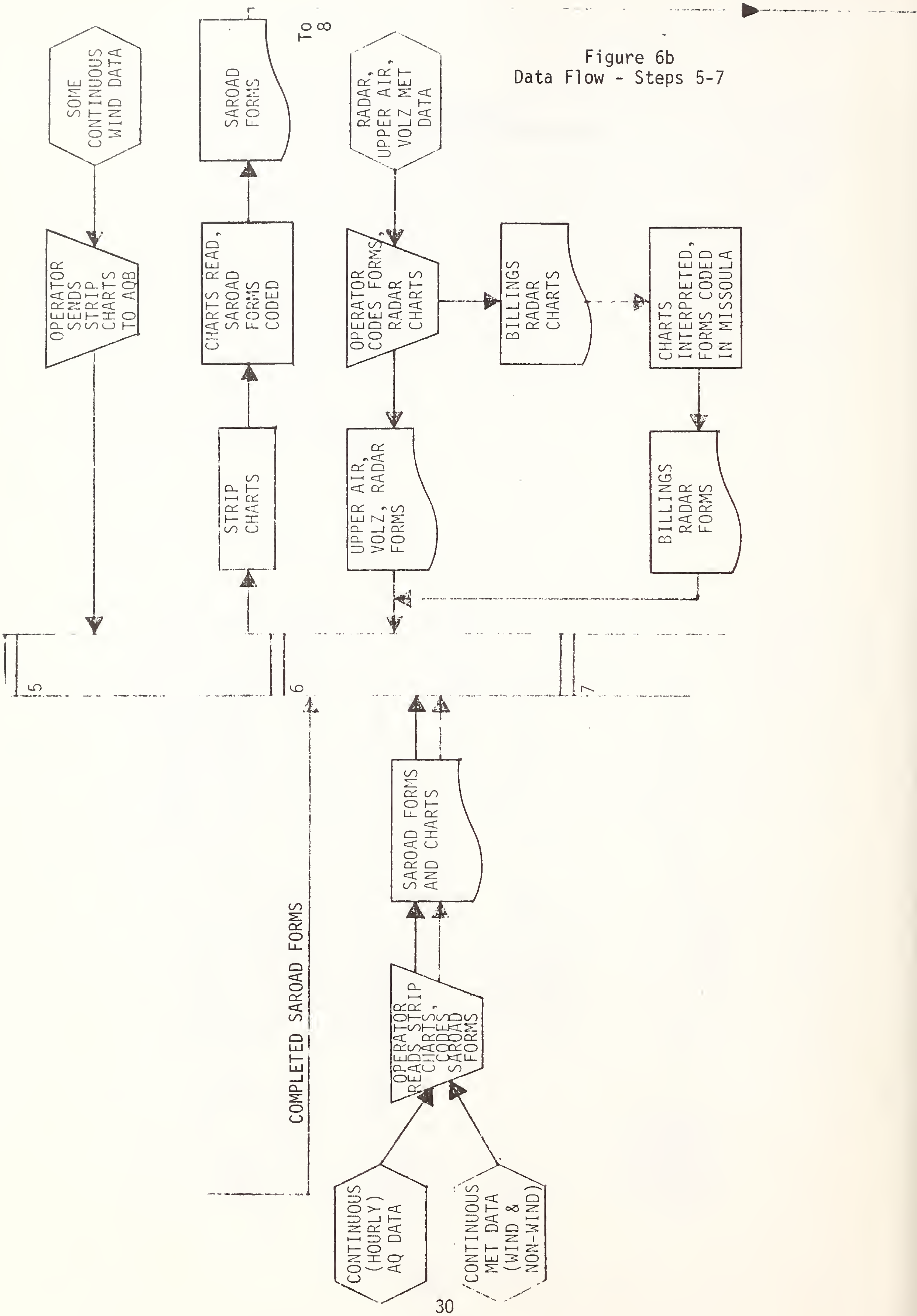

SOME CONTINUOUS WIND DATA
OPERATOR SENDS STRIP CHARTS TO AQB
5
COMPLETED SAROAD FORMS
SAROAD FORMS
To 8
CHARTS READ, SAROAD FORMS CODED
STRIP CHARTS
6
RADAR, UPPER AIR, VOLZ MET DATA
OPERATOR CODES FORMS, RADAR CHARTS
UPPER AIR, VOLZ, RADAR FORMS
BILLINGS RADAR CHARTS
CHARTS INTERPRETED, FORMS CODED IN MISSOULA
BILLINGS RADAR FORMS
7
SAROAD FORMS AND CHARTS
OPERATOR READS STRIP CHARTS, CODES SAROAD FORMS
CONTINUOUS (HOURLY) AQ DATA
CONTINUOUS MET DATA (WIND & NON-WIND)

Figure 6c
Data Flow - Steps 7-9

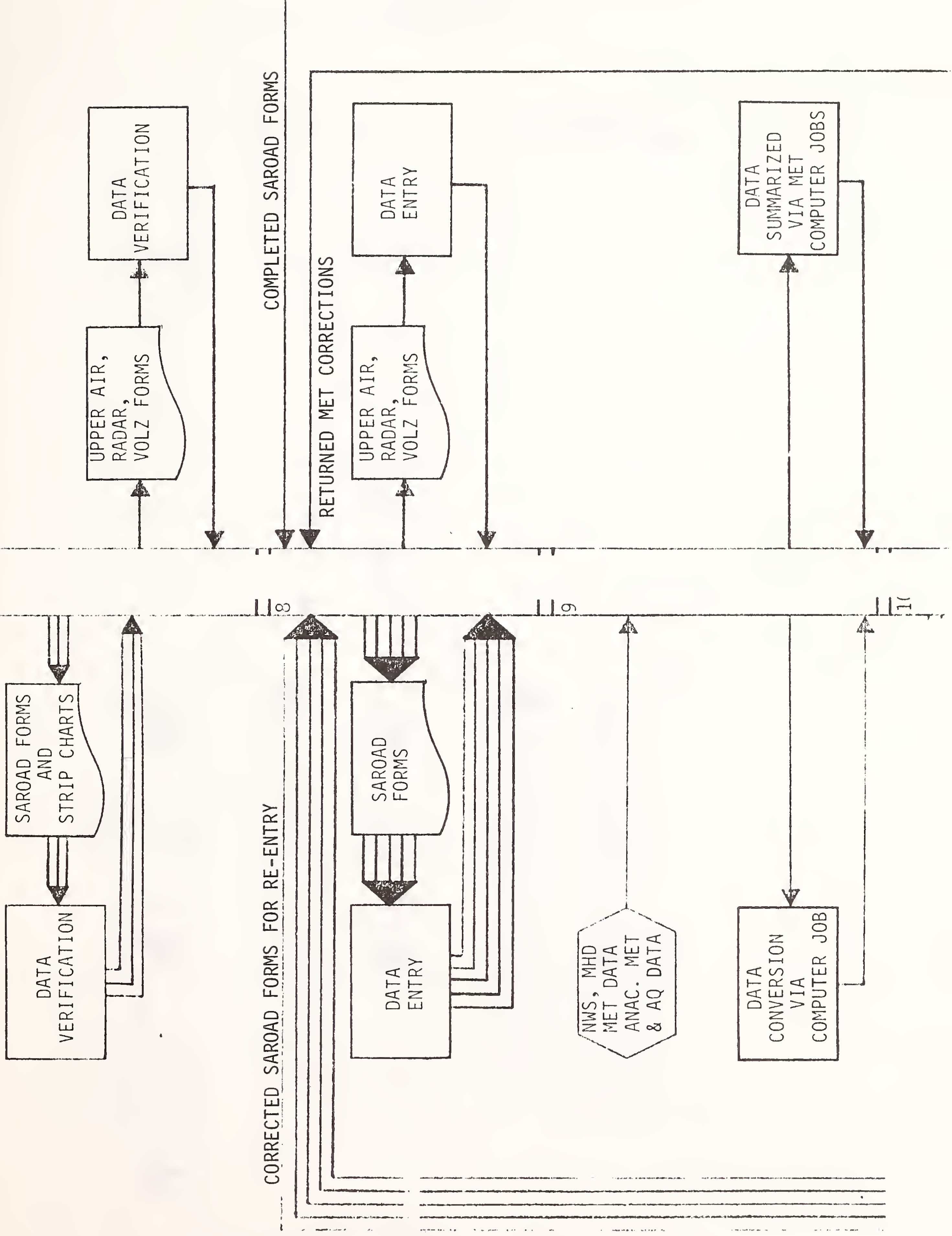

DATA VERIFICATION
UPPER AIR, RADAR, VOLZ FORMS
COMPLETED SAROAD FORMS
RETURNED MET CORRECTIONS
DATA ENTRY
UPPER AIR, RADAR, VOLZ FORMS
DATA SUMMARIZED VIA MET COMPUTER JOBS
8
9
SAROAD FORMS AND STRIP CHARTS
DATA VERIFICATION
CORRECTED SAROAD FORMS FOR RE-ENTRY
SAROAD FORMS
DATA ENTRY
NWS, MHD MET DATA ANAC. MET & AQ DATA
DATA CONVERSION VIA COMPUTER JOB

Figure 6d
Data Flow - Steps 9-12

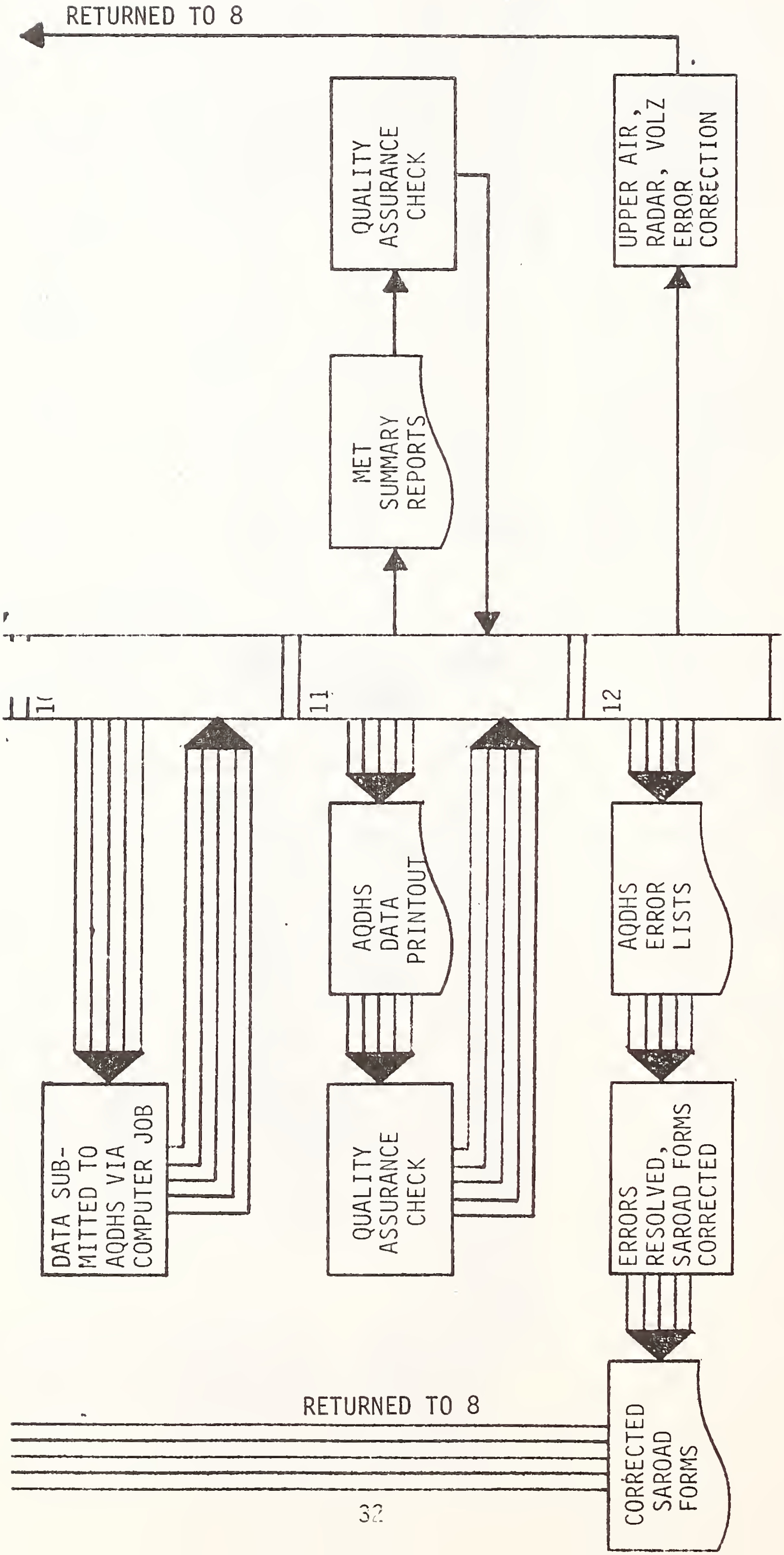
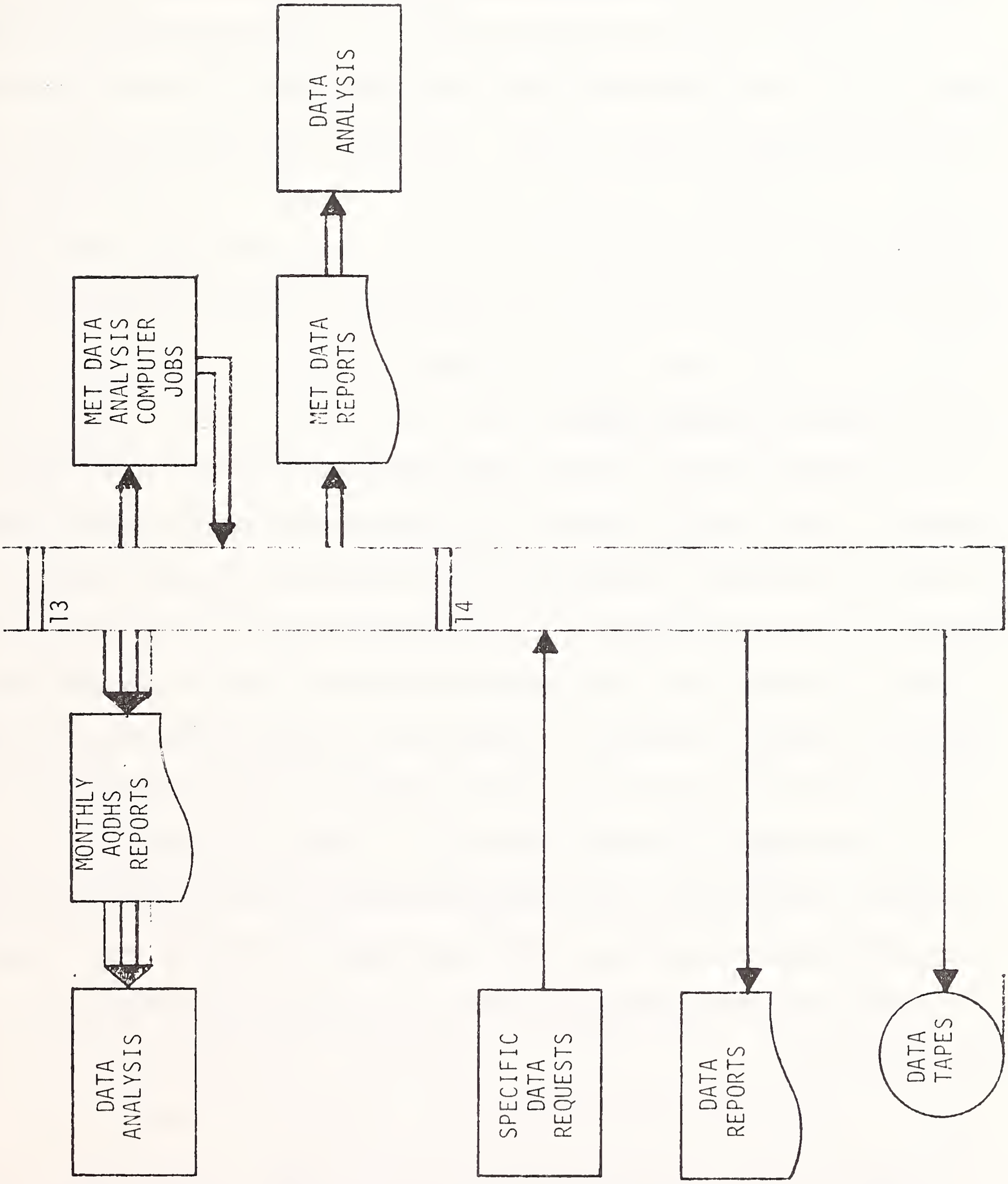


Figure 6e
Data Flow - Steps 13-14



The following discussion of the AQDHS data bank system is meant to provide an introductory overview; the detailed documentation required to run the system is compiled in reference manuals maintained by the AQB Data Processing Controller and the computer center documentation files.

In contrast to the PFT system described in the previous section, the data bank system is not organized to make primary use of the I/O controllers provided by the Computer System Division. The major focus for all users at present is the AQB Data Processing Controller. However, the system does involve the same set of elements described previously - file structures, computer programs, and production jobs, and the documentation forms are much the same, with the addition of some AQB in-house request forms.

Data Files and Coding Structures

The AQDHS-II system is designed to be compatible with a national data processing system that EPA has developed and evolved over a period of roughly 15 years. Accordingly, it utilizes file structures and numerical coding schemes that are more general, flexible, and hence complex, than would likely be required for a simpler system unique to Montana. However, through EPA mandate and financial support, the Bureau has used the various federal coding and file systems in the past, and there would be no benefit to changing now.

The data system is built around two basic coding structures - one for pollutants (parameters) and measurement methods, and another for geographic locations of monitoring sites. These are standard nationwide, and are known as SAROAD* codes, named after the national data bank maintained by EPA in North Carolina.

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*SAROAD (Storage and Retrieval of Aerometric Data) is a long-lived acronym that is now used a little loosely, as in SAROAD forms, SAROAD data, etc; care must be taken to be sure of the context.

The parameter codes come from an extensive hierarchical structure developed to permit unique codes for essentially anything and everything. A complete code consists of a five-digit parameter code specifying the pollutant, e.g., sulfur dioxide or wind speed, a two-digit method code, specifying the measurement technique or instrument, and a two-digit units code indicating the measurement units (e.g. ppm, ug/m^3, etc.) used. Method codes are unique to each parameter code.

The site coding structure is built around a two-digit state code (Montana=27), a three digit "area"code representing counties and the larger cities, and a three digit site code within each area.

The primary record format in the current AQDHS system, and the only one presented here, is the master-file record format. The basic heart of the data bank is a master file of data records. Each record contains a specific data item or items along with an entire set of identifying information, which can be used as "sort keys" to sort the data in any desired order. The master-file record format currently in use in the Montana system is presented in Table 7. Each record contains data for one parameter at one site for either one month (of daily data) or one day (of shorter-term data). This record format is known in current EPA documents as "new AQDHS" format, as opposed to "old AQDHS" or "SAROAD" formats, which involved smaller amounts of data in each record. There is also at present (autumn 1979) a newer version of AQDHS, just promulgated, which involves another basic master-file record format, incorporating some additional information.

There are many files, permanent and temporary, that are required to run the data bank system. Detailed formats, and their place in the system, can be found in the System Documentation Manual. They are listed by name and identification in Table 8.

Table 7

AQDHS MASTER FILE RECORD FORMAT

Position	Field Description
1	Action Code: This code indicates the last action that was performed on this record. The action codes are 2 = add and 3 = change.
2	Form Code: The three SAROAD transmittal-form codes currently accepted by AQDHS are: form #1, less than 24-hour sampling interval; form #2, 24-hour or greater sampling interval; and for #3, multiple station form. The corresponding AQDHS forms use the same form codes. Form #2 is also used for composite data.
3-4	State Code: State names are arranged in alphabetic sequence and assigned numbers from 01 to 52 (including the District of Columbia and Puerto Rico); Montana is code 27.
5-8	Area Code: Within each state the names of all incorporated areas with a population of more than 2500 and all counties have been arranged alphabetically and assigned a four-digit numerical code. County codes are used only for stations located outside incorporated areas.
9-11	Site: Specific sampling sites are designated by a three-digit numeric code that permits a maximum of 999 site in each city or county area within a state.
12	Agency: The type of agency responsible for the sampling is designated by a single digit alphabetic code; the agency codes are shown in Appendix C.
13-14	Project: The 2-digit numeric codes permit classifying monitoring sites according to the general purpose of the project under which the data is gathered. The principal categories are shown in Appendix C.
15	Time Code: A single-digit alphameric code which indicates sampling intervals, as shown in Appendix C.
16-17	Year: The AQDHS date validation check accepts years from 1960 to the current year.
18-21	Month and Day: The date validation check accepts months from 01 to 12, and days from 01 to the maximum for each month (29 for February).

Table 7
continued

Position	Field Description
22-23	Start Hour: A two-digit numeric code (00 to 23) that indicates the hour of the first reading.
24-28	Parameter Code: A five-digit numeric code which permits a branching subcategorization of pollutants.
29-30	Method Code: A two-digit numeric code designating the methods of collection and analysis.
31-32	Unit Code: A two-digit numeric code used to designate the unit of measurement. A partial list may be found in Appendix C.
33	Decimal Code: A single-digit numeric code from 0 to 4 which indicates the number of digits in the data field that are to fall to the right of the decimal point.
34-35	Number of Readings: A two-digit numeric field that indicates the number of repeated Data Fields and Status Flags that are in the record.
36	Status Flat: A single-digit alphabetic code indicating that the associated Data Field has been sent to the EPA SAROAD data bank (value is 'S'), or is to be sent as an Add Record (value is 'A'), or Change Record (value is 'C').
37-40	Data Field: The data fields contain the data as a signed four-digit number right-justified with leading-left zeros.

Note: The 5-byte field in Positions 36-40 is repeated to include more than one reading in each record; the number of repetitions is the value in field 34-35.

Table 8

Files in Data Bank System

Data Set Name	Contents
F05.D607.D01	Input transactions
F05.T607.D11	Sorted, valid transactions
F05.T607.M01	Current master file (5 generations)
F05.T607.M11	Historical master file
F05.D607.M21	Statistical File (temporary)
F05.D607.M41	Reformatted master file
F05.D607.M02	Key Segment - Parameter Code Table
F05.T607.M02	" " - Backup copy
F05.T607.M42	" " - Re-formatted
F05.D607.M22	Description Segment - Parameter Code Table
F05.T607.M22	" " - Backup copy
F05.D607.M03	Site Code Table
F05.T607.M03	" " " - Backup copy
F05.D607.M04	Parameter Standards Table
F05.T607.M04	" " " - Backup copy
ADDFILE, CHANGEFL	Update transactions for SAROAD submission

Note: Retrieval files are created upon specific request and assigned appropriate names.

Computer Programs

The AQDHS-II system as supplied by EPA included 19 computer programs that perform various functions, as listed in Table 9. In addition, five new programs were written to perform meteorological data pre-processing functions, a master-file inventory program was written, and a wind data frequency summary program was written. The EPA programs are discussed in some detail in the Publication EPA-450/3-74-045-1, the Second Edition (December, 1977) of the AQDHS-II Program Documentation and User's Guide. The programs written by the local systems analysts are briefly described below--further details are contained in the System Documentation Manual maintained by the Bureau Data Coordinator.

Pilot Balloon Data Processing system (Programs AIRED313, AIR00313, and AIRAQ313). These three programs and the associated cataloged procedure comprise a small subsystem that accepts raw data from the pilot balloon upper air soundings, performs extensive engineering calculations, prepares a summary report, and outputs AQDHS transaction records for input to the data bank.

Acoustic Radar Processing Program (AIRAQ314). This program accepts raw data recorded from the acoustic radar instruments, along with wind data obtained from the AQDHS data bank, and performs extensive engineering calculations to produce final-form data on inversions and vertical stability; these are summarized in a printed report and formatted for input to the data bank.

Master-file Inventory Program (RPTLST2). This program will inventory for all or selected sites, parameters and time periods, the master-file to permit knowing whether or not specific data has yet been entered.

Upper Air Frequency Summary (AIR00315). This is a retrieval program which retrieves from AQDHS the upper air data, which is not meaningfully retrieved by the standard data summaries, and summarizes it in a printed report.

As with the PFT system described previously, the normal access to the AQDHS data bank system is not directly by the stored programs, but by predefined production jobs that utilize stored cataloged procedures. The next section summarizes these jobs.

Production Jobs

Each production job involves a cataloged procedure maintained on the computer's system library disk (SYST.RUNLIB). This cataloged procedure invokes one or more of the computer programs, which are also kept on a system library disk (SYST.USERLIB), and utilizes the appropriate data files, which may need to be identified to the job by means of JCL statements. Production job, program definitions and descriptions, and file descriptions are on file in the computer center's documentation files; however, the jobs are not normally accessed by request to the I/O Control Section, as with the PFT system.

In a manner similar to the program list in Table 9, the production jobs are easily grouped by major functions, and the following brief discussions of the job are so organized.

Master File Maintenance. The file maintenance jobs provide the basic fundamental capabilities of entering the various types of data into the system, updating and correcting the master file, and maintaining the historical data file. Five computer jobs provide these functions:

EB05607A - Backup AQDHS-II transactions
EB05607B - Backup and convert SAROAD transactions
EB05607D - Edit transactions and update master file
EB05607G - Extract previous year's data
EB05607E - Merge two master files

Job EB05607A. Copies an input data set in AQDHS-II transaction format from the 3790 data entry system to a disk data set (F05.D607.D01) for subsequent entry into the transaction edit and file update jobs.

Job EB05607B. Copies an input data set in one of the old SAROAD formats from the 3790 data entry system to the input-transactions data set (F05.D607.D01), converting it to the appropriate AQDHS-II format in the process.

Job EB05607D takes the AQDHS-II format transactions in disk file F05.D607.D01, edits them for validity, and updates the master file with the valid transactions; rejected transactions are output for correction and re-entry.

Job EB05607G extracts a complete previous year's data from the current master file for addition to the historical file via Job EB05607E, leaving a new master file containing the current year's data only.

Job EB05607E merges any two files in master-file format; normally it is used after Job EB05607G in transferring a year's data from the current master file to the historical file.

Table Maintenance. The AQDHS-II tables are the files that contain the relatively stable information on site and parameter codes and air quality standards. These tables or files are used by the various edit, retrieval, and data analysis programs to check site codes, print table headings, etc. The computer jobs here are used to update and change the tables themselves; there are six such jobs:

EB05607P - Print parameter code table
EB05607Q - Print site code table
EB05607S - Print parameter standards table
EB05607T - Update and print parameter code table
EB05607U - Update and print site code table
EB05607V - Update and print parameter standards table.

Jobs EB05607 P,Q and S print the tables in up to four copies for user record.

Jobs EB05607T, U and V update the tables, making a backup copy of the old table, and printing the new table for verification.

Data Retrieval, Analysis and Reporting. These jobs provide the system's output capabilities. There are ten jobs associated with retrievals from the data bank master file:

EB05607C - Detail list report
EB05607F - Retrieve data and print detail report
EB05607H - Master file inventory report
EB05607J - Statistical analysis and report
EB05607K - Selected data retrieval
EB05607L - Calculate and print sliding averages

EB05607M - Acoustic radar report
EB05607N - Retrieve and print upper air report
EB05607R - Retrieve and convert to SAROAD format
EB056070 - Retrieve, convert to SAROAD, and sort wind data

Jobs EB05607C and F print the master file(C) or a data file extracted from the master file(F) in a detailed printed format, with a number of options.

Job EB05607H produces a master file inventory report covering the specific sites, parameters, etc. requested by the user.

Job EB05607J produces a standard printed statistical summary of a master file, or a data file extracted from a master file.

Job EB05607K extracts from the master file those records requested by user provided selection criteria; it is used primarily to select data for subsequent use by another job.

Job EB05607L computes sliding-average values over user-selected intervals; it operates on a file from job EB05607K and prints results in the detail report format.

Job EB05607M retrieves selected wind data from the master file, accepts a card file of raw acoutic radar data and NWS data, and produces a monthly summary of inversion heights.

Job EB05607N retrieves selected records from the master file and converts them to the old SAROAD format, creating a tape for data transfer or input to other programs.

Job EB056070 retrieves wind speed or wind direction data from the master file, sorts it, and converts it to SAROAD format.

File Conversion. The AQDHS-II system contains three conversion programs to convert data files from one to another format; the jobs that operate these programs are:

EB05607X - Convert AQDHS-II master file records to SAROAD format
EB05607Y - Extract SAROAD format data for EPA
EB05607Z - Convert input transactions from SAROAD to AQDHS-II

Job EB05607X reads a file retrieved from the master file in AQDHS-II format and converts it to SAROAD record format for data transfer or input to analysis programs.

Job EB05607Y creates a tape file to be sent to EPA for data reporting purposes; it extracts from the master file data that has not yet been sent to EPA, or that has been changed since previously sent, and converts it to SAROAD transaction format for input to the EPA data bank.

Job EB05607Z converts SAROAD-format input transactions to AQDHS-II format transactions.

Use of the System

The use of the various jobs and programs to accomplish the purposes of the AQDHS-II system is much less simple than the PFT system described earlier. AQDHS-II is used for storing and maintaining several different types of ambient air quality and meteorological data. Because of the wide variety of methods used in collecting and generating this data, several entry procedures are necessary to input the data to the system, as illustrated in Figure 7. The discussions of each method are numerically keyed to the Figure.

Procedure 1 is used to input data coded in one of the old SAROAD input record formats (see coding forms in Appendix D); this procedure is currently used for the hourly data from the continuous instruments. The source documents (coding forms) are entered via the 3790 data entry system; Job EB05607B copies the data set from the 3790 system, runs it through the SAROAD-to-AQDHS input transaction conversion program, and puts it into a disk file (F05.D607.D01) ready for the edit-update procedure.

Procedure 2 in Figure 7 is used to process data which is directly formatted in the new AQDHS-II input transaction formats; currently this is used for daily, monthly, or composite air quality data. The source documents (coding forms) are entered via the 3790 data entry system, and Job EB05607A copies the file of input transactions directly into the F05.D607.D01 disk file for subsequent edit and update.

Procedure 3 in the Figure represents the entry of SAROAD format machine readable data (i.e. data on punched cards or magnetic tape); the records are converted and put onto the input transaction disk file by Job EB05607Z. This procedure has been primarily used for the input of the historical data accumulated prior to the installation of the new system.

FIGURE 7

INPUT DATA FLOW DIAGRAM

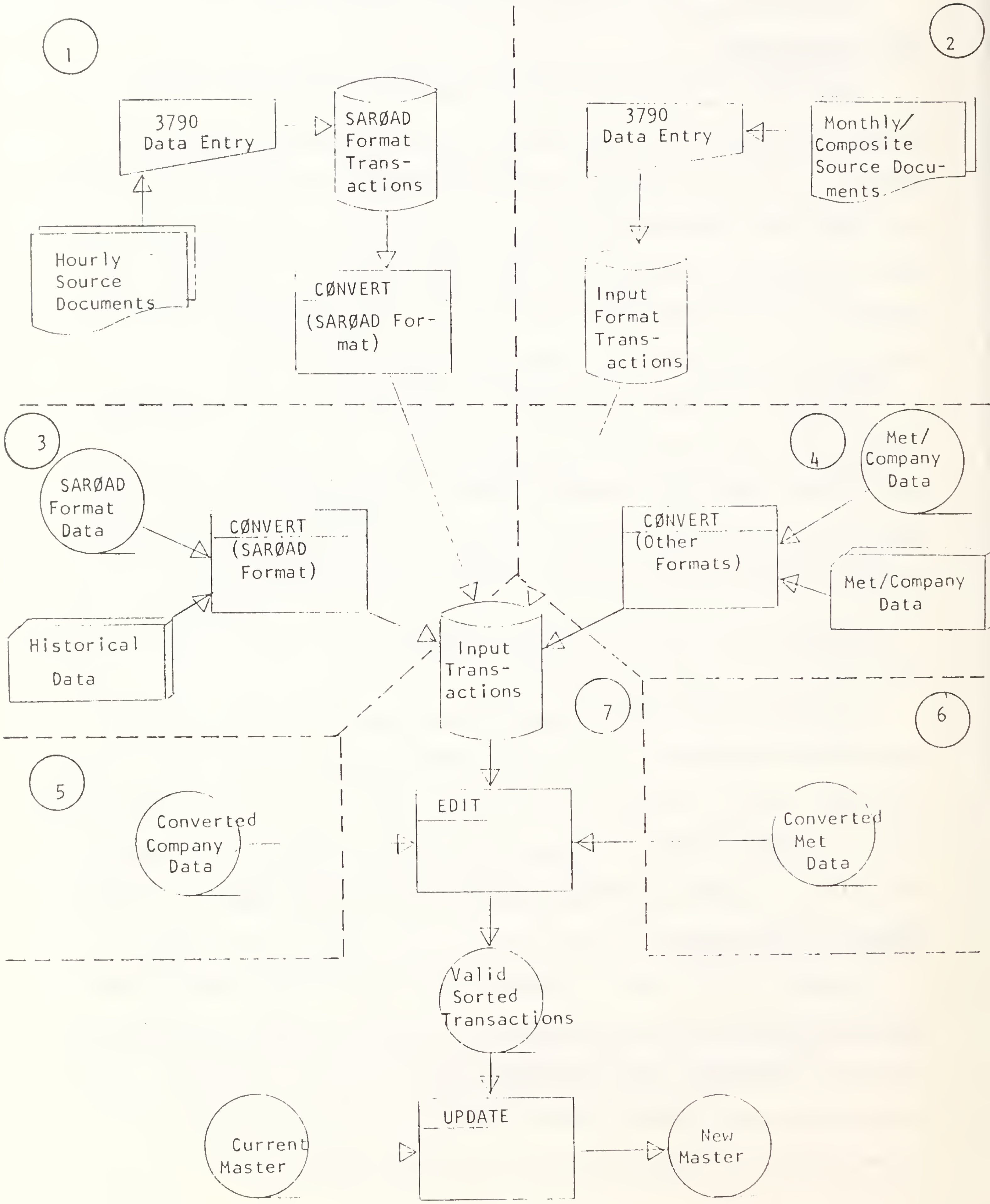

Figure 8

DATA PROCESSING REQUEST FORM

Submitted by: ______________________________

Date: ________________________ Date Required: ________________________

Request for:

____ Print Out

____ Tape ____ Retention Period

____ Other

____

____

____ Standard Detail Report

____ Statistical Analysis Report

____ Master File Inventory Report

____ Sliding Average Report

____ Acoustic Radar Report

____ Upper Air Report

____ Wind Speed and Direction Report

____ Diffuse Radiation Report

____ Other

____

____

Number of Report Copies:

____

Data Selection Criteria:

Area(s):

Site(s):

Month:

Year(s):

Parameter(s):

Other (project code, agency code, etc.):

TABLE 9

Programs in the AQDHS System

File Maintenance and Transaction Editing programs

TXTREDIT - Transaction Editor program

FXFILMT - File Maintenance program

Table Maintenance Programs

HXTABLE1 - Parameter Code Table Maintenance program

HXTABLE2 - Site Code Table Maintenance program

HXTABLE3 - Parameter Standards Table Maintenance program

PXMETHOD - Parameter Code List program

PXPRMSTD - Parameter Standards List program

Data Retreival Programs

LXLNGPRC - Retrieval Language Processor program

RTRETRVR - Retrieval program

Output Programs

EXRPTLST - Detail List program

IXLSDAVG - Sliding Average program

DXSTATIS - Data Analysis program

SXPRINTS - Statistical List program

MXSENTNL - Answer File Flagging program

NXSENTNL - Parm-Code-Key File Flagging program

File Merging Programs

AXMERGE - File Merge program

Conversion Programs

BXCONVRT - Old AQDHS File to New AQDHS-II Input program

CXCONVRT - Old AQDHS (SAROAD) Input to New AQDHS-II Input program

AXCONVRT - AQDHS-II File to SAROAD Input program

Procedures 4 and 5 in Figure 7 represent the entry of so-called "company data" and National Weather Service (NWS) data. Air quality and meteorological data are generated by a number of non-AQB sources, primarily industrial companies monitoring near their facilities and NWS's various monitoring activities. These data can be either received in non-standard but machine-standard readable form and run through appropriate conversion programs by the Air Quality Bureau (as in 4) or may be received as appropriately-formatted AQDHS-II input transactions (as in 5). The latter could also include data received as paper copy and coded or otherwise converted to proper format in the Bureau, but outside the AQDHS system. In either of procedures 4 or 5, the data can be input either to the permanent disk file F05.D607.D01 or directly to the edit/update routine. At the present time, no procedures for such "foreign" data are properly incorporated into the system.

Procedure 6 represents the similar input of "in-house" meteorological data. Some of the meteorological data collected by the Bureau, notably the various upper air parameters, require extensive calculations on the raw data to produce the final data for input to AQDHS-II. These processes are not currently included in the system, but they produce magnetic tapes with AQDHS format transactions which may be entered directly into the edit and update job.

Point 7 in Figure 7 identifies the permanent disk file (F05.D607.D01) of input transactions, which is the common "meeting place" of the data from the several possible data input procedures. The AQDHS-II format input transactions, from whatever origin, are picked up from this data set by Job EB05607D and run through the edit and update programs. These programs check the input transactions for conformance to format and code validity; it updates the data bank master file with the valid transaction records and outputs the rejected records. The Data Coordinator or other user must then ascertain, with the help of other appropriate Bureau staff if necessary, the reason for the rejection. Corrected transaction records must then be resubmitted in the same manner.

When all data for an appropriate time period, group of sites, or other set, are correctly entered, they are available for retrieval and/or summary and analysis via the appropriate retrieval jobs. However, AQDHS-II itself does not have any capability for "knowing" whether or not it has all the data it is supposed to have at any given point in time. Thus it is quite possible to summarize or otherwise use a block of data that completely entered and validated; the only available approaches to keeping track of on-going data status involve manual means outside the computer system. The current best approach to verifying data presence before running a retrieval is to request a run of JOB EB05607H and get a master file inventory report covering the data desired.

The use of the Table Maintenance routines that keep the code tables up to date is a relatively simple process. Changing entries in the tables requires the preparation of a small card deck containing the new entries, and checking the correctness of the change. Recent versions of the tables are available in the Bureau or through a simple job request. Generally, the frequency and importance of table updating depends on the stability of the monitoring network; the data bank will not accept data from a new site or new instrument until the tables have been updated to include the required codes.

The file conversion routines are similarly straightforward. Because many older systems or analysis usages still require SAROAD format, conversion routines to and from AQDHS-II format are provided. These are incorporated in several of the production jobs and can be used separately if needed via Jobs EB05607X and Z. The EB05607Y job is designed to extract from the master file the data to be sent to EPA. While it does convert the records into SAROAD format transactions, it is primarily a special purpose retrieval rather than a generally available conversion routine. Job EB05607Y is normally run quarterly to create a data tape for the EPA Region VIII Office in Denver.

The last major area of use of the data bank system is in retrieving data for summary and analysis. Without such capabilities, the storage and archiving of the data would be a wasted effort. Unfortunately, the summary and analysis capabilities of the AQDHS-II system are not its strongest feature; the local systems analysts have had to expand the capabilities significantly, and further improvements would be desirable. The following description documents the output capabilities of the system, as well as the procedures with which they are presently utilized. The latter have not been used extensively, and may require change as experience accumulates. At present, any retrieval can be requested on an AQB in-house form submitted to the Data Coordinator (Figure 8).

There are basically three general types of retrievals available to the user. The EPA system provided two--a series of fixed-format retrievals that are basically data summaries, and a general-purpose retrieval routine to extract data for other user purposes. The third general type consists of the special-purpose summaries written by the state for the meteorological data that could not be handled by the standard AQDHS routines.

The standard data summaries are accessed through the jobs EB05607C, F and J, which provide a detailed data listing, or a statistical summary, respectively. The detail list (Job EB05607C) formats and lists the master file or any file in the same record format, such as an extraction from the master file, or Job EB05607F will extract data from the master file and print a detailed report in one step. Depending on the type of data, the output appears as illustrated in Figures 9 and 10. (These tabulations are modified from those initially provided by the EPA system.)

FIGURE 9 - SAMPLE OUTPUT FROM DETAIL LIST ROUTINE - 24-HOUR DATA

```
                                         STATE OF MONTANA - DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
                                         AIR QUALITY DATA REPORT                                        REPORT DATE: 11/05/79          PAGE   461

PARAMETER: SUSPENDED PARTICULATE                        (11101) UNITS: MICROGRAMS/CUBIC METER             (01) MIN DET:        1 DECIMAL CODE: 1
COLLECTION METHOD: HI-VOL                                   (91) ANALYSIS METHOD: GRAVIMETRIC                  SAMPLING INTERVAL: DAILY

SITE: MISSOULA CO - LIONS PARK #1 HIVOL & CONTINUOUS                     MAPS (1100-019) AGENCY: STATE                                 (F)
PROJECT: POPULATION-ORIENTED SURV.         (01)                                                                     YEAR: 1979  MONTH:

MONTANA STANDARD:               000200MICROGRAMS/CUBIC METER-24 HR MAX-1% OF TIME
FEDERAL PRIMARY STANDARD:       000260MICROGRAMS/CUBIC METER-24 HR MAX-1 PER YEAR
FEDERAL SECONDARY STANDARD:     000150MICROGRAMS/CUBIC METER-24 HR MAX-1 PER YEAR

                                                            MONTH
DAY      JAN       FEB       MAR       APR       MAY       JUN       JUL       AUG       SEP       OCT       NOV       DEC       NO.      MEAN       MAX
01      131.1      93.8     151.4      64.1      60.1      86.0      59.7     101.3      38.0                                     9      65.3     151.4
02      111.1     147.6     221.6      93.8      46.9      81.9      66.9      86.3      33.5                                     9      99.1     221.6
03       93.3     122.5     265.5      85.2      94.5      82.0      57.1      97.6      36.7                                     9     103.9     265.5
04       54.7     154.3     301.4     135.3      66.7     104.6      73.9      72.7      60.0                                     9     113.4     301.4
05      109.9      46.8     419.4     129.1      36.3     111.9      68.0      94.8      66.4                                     9     120.3     419.4
06      147.6      46.8     195.4     127.3      23.7     108.1      74.4      63.3     102.0                                     9      96.7     195.4
07      152.8      20.4     141.3      65.2      47.1      42.5      59.5     106.1     114.9                                     9      81.4     152.8
08      179.4      38.9     120.4      99.4      27.3      57.7      55.6      98.3      90.3                                     9      85.3     179.4
09      116.5     145.0     214.2      25.9      40.6      20.2      66.5      86.4      29.4                                     9      84.3     214.2
10       81.7     143.0     246.4      56.0      98.8      64.1     161.5     100.4      73.4                                     9     114.1     246.4
11       84.5      60.4     271.0      97.1      96.1                59.7      99.0      85.7                                     8     107.4     271.0
12       42.6      46.2     233.8      56.1      84.4     121.0                62.8      90.8                                     8      92.3     233.8
13       96.0      42.8     167.7      65.5      65.9                56.6      54.5      90.2                                     7      82.4     167.7
14       48.6      52.2     233.9      74.1      78.5      84.7      51.3      30.7     137.3                                     8      87.9     233.9
15       50.9     100.1     340.9      52.2     130.1      78.6      54.6      58.7      98.1                                     9     105.0     340.9
16      221.0     105.9     169.5     111.7      90.8      64.7      92.0      46.8     113.5                                     9     115.1     221.0
17      137.0     112.1      86.7      60.8      91.5      37.6      96.6      75.0     101.8                                     9      89.1     137.0
18      149.4      58.4      68.2      70.2     134.3      43.2     117.0      49.0     154.5                                     9      96.0     154.5
19      101.3      57.5      78.4      81.4     104.9      49.3     111.8      33.7     103.9                                     9      80.8     111.8
20      120.4     211.9      62.4      59.6      64.2      58.3     129.5      42.5     153.9                                     9     100.3     211.9
21       95.1      88.7     116.0      92.4     119.9      58.3     135.9      76.5     154.9                                     9     100.6     154.9
22       76.1      98.2     103.9      57.3      91.7      70.3      52.4      48.6     115.7                                     9      79.4     115.7
23      130.7     212.9     152.0      41.6     120.6      55.0      58.0     111.1      69.2                                     9     105.7     212.9
24      121.2     126.3     292.3      53.4      56.9      58.2      94.2      51.5     116.7                                     9     109.0     292.3
25      101.0     149.3     136.0      66.0      53.4      69.3      53.5      40.5     131.7                                     9      94.5     149.3
26       88.1     142.5      90.7     103.5      70.1      68.2      67.0      39.1      92.3                                     9      84.6     142.5
27       96.7     208.8      43.9     128.2     128.5      65.7      76.2      62.5      90.5                                     9     100.7     208.8
28       77.3      70.0      77.3     134.5      38.0      67.1      45.2      56.9     127.7                                     9      77.2     134.5
29       98.0               111.0     106.5      49.1      84.7      44.9      56.7      77.2                                     8      78.5     111.0
30      132.3                79.1      69.2      45.1     102.3      65.0      77.8      67.8                                     8      79.8     132.3
31      116.1                53.1                47.3                68.9      73.7                                               5      71.8     116.1

NO         31        28        31        30        31        26        30        31        30         0         0         0      270
MEAN    108.4     103.9     170.5      82.9      75.4      72.5      73.9      69.1      93.9                                              94.8
MAX     221.0     212.9     419.4     135.3     134.3     121.0     161.5     111.1     154.9                                                        419.4

NUMBER OF TIMES ABOVE MONTANA VALUE:      0
NUMBER OF TIMES ABOVE FEDERAL PRIMARY VALUE:      0
NUMBER OF TIMES ABOVE FEDERAL SECONDARY VALUE:      0

GMEAN    0.83     88.96     44.88     77.27     67.89     68.03     69.06     64.47     85.95    ******    ******    ******
```

FIGURE 10 - SAMPLE OUTPUT FROM DETAIL LIST ROUTINE - HOURLY DATA

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                                      STATE OF MONTANA - DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
                                      AIR QUALITY DATA REPORT                                            REPORT DATE: 08/07/79          PAGE      3

PARAMETER: SULFUR DIOXIDE                            (42401) UNITS: PARTS PER MILLION                   (07) MIN DET:   .005 DECIMAL CODE: 2
COLLECTION METHOD: INSTRUMENTAL                         (20) ANALYSIS METHOD: PULSED FLUORESCENT             SAMPLING INTERVAL: 01 HOURS

SITE: ANACONDA LINCOLN SCHOOL #1 -HIVOL & CONTINUOUS              MAPS (0020-007) AGENCY: STATE                              (F)
PROJECT: POPULATION-ORIENTED SURV.            (01)                                                        YEAR: 1979  MONTH: MAY

MONTANA STANDARD:              00.250PARTS PER MILLION-1 HR MAX-1 PER 4 DAYS
FEDERAL PRIMARY STANDARD:      00.140PARTS PER MILLION-24 HR MAX-1 PER YEAR
FEDERAL SECONDARY STANDARD:    00.500PARTS PER MILLION-3 HR MEAN-1 PER YEAR

DAY                                                         HOUR
      00    01    02    03    04    05    06    07    08    09    10    11    12    13    14    15    16    17    18    19    20    21    22    23   AVG   MAX
01   .02   .02   .01   .01   .02   .01   .01   .32   .06   .01   .01   .01   .01   .01   .00   .00   .00   .00   .00   .00   .00   .04   .14   .07   .02   .14
02   .12   .03   .01   .03   .03   .02   .06   .18   .29   .43   .72   .33   .03   .03   .06   .03   .02   .01   .00   .06   .01   .01   .04   .34   .11   .72
03   .05   .03   .03   .03   .03   .03   .03   .03   .04   .02                           .08   .07   .05   .01   .01   .07   .14   .06   .03   .05   .04   .14
04   .05   .06   .06   .06   .04   .04   .02   .02   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .05   .00   .02   .06
05   .01   .03   .05   .02   .03   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .01   .05
06   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
07   .00   .00   .00   .00   .00   .00   .00   .00   .00   .01   .13   .21   .04   .03   .02   .04   .12   .02   .00   .02   .01   .00   .00   .00   .03   .21
08   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
09   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
10   .00   .00   .00   .00   .00   .00   .03   .06   .00   .00   .00         .00         .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .06
11   .00   .00   .00   .00   .00   .00   .00         .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
12   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
13   .00   .00   .00   .03   .02   .02   .01   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .03
14   .00   .00   .00   .00   .00   .00   .00   .01   .11   .23   .28   .01                     .00   .00   .00   .00   .00   .00   .00   .00   .01   .03   .28
15   .02   .04   .05   .04   .04   .02                                     .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .01   .05
16   .00   .00   .00   .00   .00   .01   .01   .03   .08   .03   .03   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .01   .08
17   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
18   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
19   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00                                                                         .00   .00
20                                           .50   .68   .93   .35   .34   .09   .01   .01   .00   .00   .00   .00   .00   .00   .00   .00   .00   .17   .93
21   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00                     .02   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .02
22   .00   .00   .00   .00   .00   .00   .00   .00   .03   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .03
23   .01   .01   .00   .00   .01   .01   .03   .02   .20   .83   .50   .27   .14   .01   .00   .12   .13   .00   .00   .00   .00   .00   .00   .00   .10   .83
24   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
25   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
26   .00   .00   .00   .00   .04   .08   .04   .04   .09   .29   .01   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .02   .29
27   .00   .00   .00   .00   .00   .00   .00   .00   .10   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .10
28   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
29   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
30   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00
31   .00   .00   .00   .00   .00   .00   .00   .00   .01   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .00   .01

      30    30    30    30    30    30    29    29    30    30    29    27    27    26    29    30    30    30    30    30    30    30    30    30    NO
     .01   .01   .01   .01   .01   .01   .01   .03   .05   .09   .07   .04   .01   .00   .01   .01   .01   .00   .00   .01   .01   .00   .01   .01    MEAN
     .12   .06   .06   .06   .04   .08   .06   .50   .68   .93   .72   .34   .14   .03   .08   .12   .13   .02   .01   .07   .14   .06   .14   .07    MAX

NUMBER OF TIMES ABOVE MONTANA VALUE:     0                                                            TOTAL NBR READINGS        706
NUMBER OF TIMES ABOVE FEDERAL PRIMARY VALUE:     0                                                    MONTHLY MEAN              .02
NUMBER OF TIMES ABOVE FEDERAL SECONDARY VALUE:     0                                                  MONTHLY MAX               .93
```

FIGURE 11 - SAMPLE OUTPUT FORM - STATISTICAL ANALYSIS PROCEDURE

```
                                    STATE OF MONTANA - DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
                                    STATISTICAL ANALYSIS REPORT                                     REPORT DATE: 12/04/79          PAGE     2

PARAMETER: TOTAL HYDROCARBONS                    (43101) UNITS: PARTS PER MILLION                 (07) MIN DET:      .2 DECIMAL CODE: 2
COLLECTION-METHOD: INSTRUMENTAL                     (11) ANALYSIS METHOD: FLAME IONIZATION              SAMPLING INTERVAL: 01 HOURS

SITE: MISSOULA CO - LIONS PARK #1 HIVOL & CONTINUOUS             MAPS (1100-019) AGENCY: STATE                              (F)
PROJECT: POPULATION-ORIENTED SURV.         (01)                                                              YEAR: 1979  MONTH: 01

MONTANA STANDARD:                                                                                         DAY: 01 START HOUR: 00
FEDERAL PRIMARY STANDARD:
FEDERAL SECONDARY STANDARD:                                                                               PERIOD: 79/01/01 TO 79/10/14

                                                                 PERCENTILES
      SITE         NUM  ,       MIN                              -----------                                                MAX
      NUM          OBS          OBS      10       30       50       70       90       95       96       97       98       99       OBS
      ---          ---          ---      --       --       --       --       --       --       --       --       --       --       ---
      019            2,280      1.25     1.75     2.00     2.25     2.50     3.13     3.50     3.63     3.75     4.13     4.63      5.88

                               HIGH READINGS        PERCENT       ARITH        STD         GEO          GEO
                                (2)      (3)        ACTUAL        MEAN         DEV         MEAN         DEV
                               -----    -----       -------       -----        ---         ----         ---
                               5.75     5.75         33.1          2.36        0.61         2.29        1.26
------------------------------------------------------------------------------------------------------------------------------------------
                                    STATISTICAL ANALYSIS REPORT                                     REPORT DATE: 12/04/79          PAGE     2

PARAMETER: OZONE                                 (44201) UNITS: PARTS PER MILLION                 (07) MIN DET:    .005 DECIMAL CODE: 3
COLLECTION-METHOD: INSTRUMENTAL                     (11) ANALYSIS METHOD: CHEMILUMINESCENCE             SAMPLING INTERVAL: 01 HOURS

SITE: MISSOULA CO - LIONS PARK #1 HIVOL & CONTINUOUS             MAPS (1100-019) AGENCY: STATE                              (F)
PROJECT: POPULATION-ORIENTED SURV.         (01)                                                              YEAR: 1979  MONTH: 01

MONTANA STANDARD:                                                                                         DAY: 01 START HOUR: 00
FEDERAL PRIMARY STANDARD:     00.120PARTS PER MILLION-1 HR MAX-1 PER YEAR
FEDERAL SECONDARY STANDARD:                                                                               PERIOD: 79/01/01 TO 79/10/14

                                                                 PERCENTILES
      SITE         NUM          MIN                              -----------                                                MAX
      NUM          OBS          OBS      10       30       50       70       90       95       96       97       98       99       OBS
      ---          ---          ---      --       --       --       --       --       --       --       --       --       --       ---
      019            3,195      0.0      0.002    0.002    0.010    0.022    0.035    0.042    0.043    0.045    0.048    0.054     0.075

                               HIGH READINGS        PERCENT       ARITH        STD         GEO          GEO
                                (2)      (3)        ACTUAL        MEAN         DEV         MEAN         DEV
                               -----    -----       -------       -----        ---         ----         ---
                               0.069    0.065        46.4         0.015       0.014        0.009       2.986
```

There is an option available to the user, Display, which permits requesting that only certain values be printed, by specifying limits in logical syntax; e.g. DISPLAY 10.00 would provide for printing only those values over 10. For detailed instructions in coding these options, refer to the System Documentation Manual.

The other standard retrieval, the statistical analysis routine, is available through Job EB05607J. This job performs various statistical analyses on data contained in a master file or master-file-format retrieval file. Composite data may not be used as input. The results of the calculations are written to a temporary file which is then formatted and printed by the statistical list program. The following statistical information is computed: minimum and maximum observations; arithmetic mean and standard deviation; geometric mean and standard deviation; percentage of readings present; and the 10th, 30th, 50th, 70th, 90th, 95th, 96th, 97th, 98th and 99th percentile occurrence. A sample output from Job EB05607J is presented in Figure 11.

The third standard output available from the EPA system summarizes sliding averages, and involves running three jobs. The Job EB05607L computes the values of the sliding average for arbitrary intervals selected by the user on data contained in a sliding average retrieval file previously generated by the data retrieval job EB05607K. The computed values are stored on a temporary data set which is then printed by the detail list program under Job DB05607C.

Prior to executing Job EB05607L, a sliding average input file must have been generated via Job EB05607K, operating under the option SLIDING. When requesting this job, the user must supply the data set name and volume number for that file, as well as the sliding average control card used to specify the interval over which the sliding average is to be computed. The format of this control card and other detailed are best obtained from the Documentation Manual.

The user who requires summaries other than those available via the above jobs, or who wishes to do statistical analyses on the data, must extract the desired data from the master file via Job EB05607K and then provide separate programming to process the data as desired. The retrieval routine in Job EB05607K is fairly flexible. It accepts a series of COBOL-type logical specifications that identify the parameters, time periods, etc., that are desired, and then generates a retrieval program run to extract the records meeting the specifications. It has options to create a sliding average file if desired for use in Job EB05607L, and to list all the records extracted if desired. The details of preparing a request are best obtained from the System Documentation Manual, as they are relatively intricate, but the following is a typical example of a retrieval request:

```
$$SELECT                      SLIDING            LIST
PARAMETER-CØDE                + '11101'          AND
YEAR                            '74'             AND
(MØNTH                        = '06'             ØR
MØNTH                         = '07'
$SEND
```

This request will create a sliding average retrieval file of records for parameter code 11101, for the months of June and July for all years more recent than 1974. The selected records will be printed.

The third major type of retrieval consists of the special-purpose meteorological summaries that were written to handle data that cannot be meaningfully summarized by the EPA-provided standard program. These programs are invoked by Jobs EB05607M, N and O, which produce summaries as follows:

EB05607M - Acoustic radar derived data on inversion height, type, and frequency;

FIGURE 12 - ACOUSTIC RADAR DAILY INVERSION SUMMARY

ACOUSTIC RADAR ANALYSIS

FLATHEAD ENVIRONMENTAL STUDY MONTH OF MAY 1979

FIRST INVERSION

DAY	0000-0600 MST			0601-1200 MST			1201-1800 MST			1801-2400 MST		
	BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *
1	0	3	4	0	2	4	N	N	N	0	1	4
2	0	2	4	N	N	N	N	N	N	0	2	4
3	0	2	4	N	N	N	N	N	N	0	1	3
4	0	2	3	0	2	3	N	N	N	0	3	3
5	0	3	3	N	N	N	N	N	N	0	2	4
6	0	4	4	1	4	4	N	N	N	0	1	3
7	0	2	4	N	N	N	N	N	N	0	2	4
8	0	3	4	1	4	4	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	0	2	3
10	0	2	3	0	1	3	0	1	3	0	2	4
11	0	2	4	0	4	4	N	N	N	0	2	4
12	0	2	4	N	N	N	N	N	N	0	3	4
13	0	3	4	0	3	4	N	N	N	N	N	N
14	0	2	3	N	N	N	N	N	N	0	2	4
15	0	3	4	0	1	4	N	N	N	0	4	4
16	0	4	4	2	5	4	N	N	N	0	3	4
17	0	3	3	N	N	N	N	N	N	0	2	4
18	0	2	4	1	3	4	N	N	N	0	2	4
19	0	2	4	N	N	N	N	N	N	N	N	N
20	0	2	3	N	N	N	N	N	N	0	2	4
21	0	3	4	N	N	N	N	N	N	0	2	4
22	2	3	3	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	0	2	4
24	0	2	4	N	N	N	N	N	N	M	M	M
25	0	2	4	N	N	N	N	N	N	0	2	4
26	0	5	4	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	0	2	4
28	0	2	4	N	N	N	N	N	N	0	2	4
29	N	N	N	N	N	N	N	N	N	0	2	4
30	0	2	4	4	5	4	N	N	N	0	2	4
31	0	3	4	3	5	4	N	N	N	0	2	4

SECOND INVERSION

DAY	0000-0600 MST			0601-1200 MST			1201-1800 MST			1801-2400 MST		
	BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *	BASE (100M)	TOP (100M)	TYPE *
1	N	N	N	N	N	N	N	N	N	N	N	N
2	N	N	N	N	N	N	N	N	N	N	N	N
3	N	N	N	N	N	N	N	N	N	N	N	N
4	N	N	N	N	N	N	N	N	N	N	N	N
5	N	N	N	N	N	N	N	N	N	N	N	N
6	N	N	N	N	N	N	N	N	N	N	N	N
7	N	N	N	N	N	N	N	N	N	N	N	N
8	N	N	N	N	N	N	N	N	N	N	N	N
9	N	N	N	N	N	N	N	N	N	N	N	N
10	N	N	N	N	N	N	N	N	N	N	N	N
11	N	N	N	N	N	N	N	N	N	N	N	N
12	N	N	N	N	N	N	N	N	N	N	N	N
13	N	N	N	N	N	N	N	N	N	N	N	N
14	N	N	N	N	N	N	N	N	N	N	N	N
15	N	N	N	3	4	4	N	N	N	N	N	N
16	5	6	4	N	N	N	N	N	N	N	N	N
17	N	N	N	N	N	N	N	N	N	N	N	N
18	N	N	N	N	N	N	N	N	N	N	N	N
19	N	N	N	N	N	N	N	N	N	N	N	N
20	N	N	N	N	N	N	N	N	N	N	N	N
21	N	N	N	N	N	N	N	N	N	N	N	N
22	N	N	N	N	N	N	N	N	N	N	N	N
23	N	N	N	N	N	N	N	N	N	N	N	N
24	N	N	N	N	N	N	N	N	N	M	M	M
25	N	N	N	N	N	N	N	N	N	N	N	N
26	N	N	N	N	N	N	N	N	N	N	N	N
27	N	N	N	N	N	N	N	N	N	N	N	N
28	N	N	N	N	N	N	N	N	N	N	N	N
29	N	N	N	N	N	N	N	N	N	N	N	N
30	4	5	4	N	N	N	N	N	N	N	N	N
31	N	N	N	N	N	N	N	N	N	N	N	N

NOTE: FOR TYPE 1=FRONTAL,2=SUBSIDENCE,3=RADIATION (SPIKED ECHO)
4=RADIATION (LAMINAR ECHO) 9=UNKNOWN
N=NO INVERSION M=MISSING DATA OR UNKNOWN

FIGURE 13 - ACOUSTIC RADAR MONTHLY INVERSION FREQUENCY TABLE

```
                                   ACOUSTIC RADAR ANALYSIS

FLATHEAD ENVIRONMENTAL STUDY                              MONTH OF MAY     1979

          ******* FIRST INVERSION FREQUENCY OF OCCURENCE TABLE *******

THICKNESS           INVERSION BASE HEIGHT (IN METERS)
 (METERS)   SFC    100    200    300    400    500    600    700    800    900     TOTAL

---TIME    0- 600 MST ---------------------------------------------------------------------

  001-100     0      0      1      0      0      0      0      0      0      0        1
  101-300    23      0      0      0      0      0      0      0      0      0       23
  301-500     3      0      0      0      0      0      0      0      0      0        3
  501-900     0      0      0      0      0      0      0      0      0      0        0
NO INVERSION                                                                          4

   TOTAL     26      0      1      0      0      0      0      0      0      0       31

---TIME  601-1200 MST ---------------------------------------------------------------------

  001-100     2      0      0      0      1      0      0      0      0      0        3
  101-300     3      3      1      1      0      0      0      0      0      0        8
  301-500     1      0      0      0      0      0      0      0      0      0        1
  501-900     0      0      0      0      0      0      0      0      0      0        0
NO INVERSION                                                                         19

   TOTAL      6      3      1      1      1      0      0      0      0      0       31

---TIME 1201-1800 MST ---------------------------------------------------------------------

  001-100     1      0      0      0      0      0      0      0      0      0        1
  101-300     0      0      0      0      0      0      0      0      0      0        0
  301-500     0      0      0      0      0      0      0      0      0      0        0
  501-900     0      0      0      0      0      0      0      0      0      0        0
NO INVERSION                                                                         30

   TOTAL      1      0      0      0      0      0      0      0      0      0       31

---TIME 1801-2400 MST ---------------------------------------------------------------------

  001-100     3      0      0      0      0      0      0      0      0      0        3
  101-300    21      0      0      0      0      0      0      0      0      0       21
  301-500     1      0      0      0      0      0      0      0      0      0        1
  501-900     0      0      0      0      0      0      0      0      0      0        0
NO INVERSION                                                                          5

   TOTAL     25      0      0      0      0      0      0      0      0      0       30


----------------- FREQUENCY SUMMARY FOR FIRST INVERSION -----------------------

  001-100     6      0      1      0      1      0      0      0      0      0        8
  101-300    47      3      1      1      0      0      0      0      0      0       52
  301-500     5      0      0      0      0      0      0      0      0      0        5
  501-900     0      0      0      0      0      0      0      0      0      0        0
NO INVERSION                                                                         58

   TOTAL     58      3      2      1      1      0      0      0      0      0      123
```

FIGURE 14 - ACOUSTIC RADAR DAILY STABILITY ANALYSIS SUMMARY

```
                         ACOUSTIC RADAR ANALYSIS
FLATHEAD ENVIRONMENTAL STUDY                      MONTH OF MAY       1979


********** TWO HOUR STABILITY ANALYSIS *****************************

        ---------------------- HOUR ----------------------------------
DAY     02    04    06    08    10    12    14    16    18    20    22    24
 1      D     E     D     E     D     D     C     B     D     D     F    .F
 2      F     E     D     D     D     C     C     B     D     D     E     D
 3      D     D     F     D     D     C     C     C     D     D     E     E
 4      E     E     D     D     D     D     D     D     D     D     E     E
 5      E     E     E     D     D     C     C     C     D     D     E     E
 6      E     E     E     D     C     C     C     D     D     E     D     D
 7      D     E     D     D     D     D     D     C     C     D     E     E
 8      E     E     E     D     C     C     C     C     D     D     D     D
 9      D     D     F     D     D     D     D     D     D     D     E     D
10      D     D     D     D     D     D     D     D     D     D     E     E
11      D     F     F     F     D     C     C     D     D     D     F     F
12      F     F     F     D     D     C     C     D     D     D     E     D
13      D     E     D     F     D     D     D     D     D     D     D     F
14      F     F     F     D     D     D     C     C     C     D     E     E
15      E     D     E     D     D     C     D     D     D     E     F     F
16      E     E     D     D     D     D     C     C     D     F     D     D
17      D     F     D     D     D     D     D     C     D     D     E     E
18      F     E     E     D     D     C     C     C     D     D     E     D
19      D     F     D     D     D     C     C     C     C     D     D     F
20      D     F     F     D     D     D     D     D     C     D     E     E
21      E     E     E     D     C     C     C     C     C     D     F     F
22      D     D     D     D     D     D    .D     D     D     D     D     D
23      D     D     D     D     D     D     C     D     D     D     E     E
24      E     E     E     D     D     C     C     M     M     M     M     M
25      F     E     E     D     C     C     C     C     D     D     E     E
26      F     F     D     D     C     B     C     D     D     D     D     D
27      D     D     D     D     C     C     C     C     C     D     F     F
28      F     E     E     D     D     D     D     D     C     D     E     D
29      D     D     E     D     C     B     D     D     C     D     F     F
30      F     F     F     D     C     C     C     C     D     D     F     F
31      E     E     E     D     C     C     C     C     C     D     E     E
                 PERCENT FREQUENCY OF OCCURENCE FOR EACH CATEGORY
    A=  0.0 %  B=  1.1 %  C=18.0 %  D=51.1 %  E=17.2 %  F=11.3 %
    U=  0.0 %  M=  1.3 %  -
NOTE: U=UNKNOWN M=MISSING DATA
       CLOUD COVER CONDITIONS USED FROM NWS STATION  AT KALISPELL
       WIND DATA USED FROM NWS STATION AT KALISPELL
```

```
                  FREQUENCY SUMMARY OF UPPER LEVEL WINDS (PERCENTAGES)
LOCATION: BUTTE - AIRPORT - MAPS - MET.
100 METER LEVEL WINDS MORNING          JULY,1979
 DIRECTION   ********* WIND SPEEDS METERS/SECOND ***************************
             00.1  03.0  06.0  10.0  16.0  GREATER      ROW  SUMMARY
              TO    TO    TO    TO    TO    THAN     TOTAL  TOTAL  AVERAGE
             02.9  05.9  09.9  15.9  25.0   25.0     COUNT  PERCENT  SPEED

     N             11.1                                1     11.1     3.8
   NNE                                                 0      0.0
    NE                                                 0      0.0
   ENE       11.1                                      1     11.1     1.2
     E                                                 0      0.0
   ESE                                                 0      0.0
    SE                                                 0      0.0
   SSE                                                 0      0.0
     S       22.2  22.2                                4     44.4     2.9
   SSW                                                 0      0.0
    SW                                                 0      0.0
   WSW                                                 0      0.0
     W                                                 0      0.0
   WNW                                                 0      0.0
    NW       11.1                                      1     11.1     1.5
   NNW       11.1        11.1                          2     22.2     4.4

  CALM                                                 0      0.0

COL. TOTALS  55.5  33.3  11.1                          9              3.0
100 METER LEVEL WINDS AFTERNOON        JULY,1979
 DIRECTION   ********* WIND SPEEDS METERS/SECOND ***************************
             00.1  03.0  06.0  10.0  16.0  GREATER      ROW  SUMMARY
              TO    TO    TO    TO    TO    THAN     TOTAL  TOTAL  AVERAGE
             02.9  05.9  09.9  15.9  25.0   25.0     COUNT  PERCENT  SPEED

     N       12.5                                      1     12.5      .7
   NNE                                                 0      0.0
    NE                                                 0      0.0
   ENE                                                 0      0.0
     E       12.5                                      1     12.5     2.8
   ESE                   12.5                          1     12.5     8.9
    SE             12.5                                1     12.5     3.0
   SSE                                                 0      0.0
     S                                                 0      0.0
   SSW                                                 0      0.0
    SW             12.5  12.5                          2     25.0     5.5
   WSW                                                 0      0.0
     W                                                 0      0.0
   WNW                                                 0      0.0
    NW       12.5                                      1     12.5     2.1
   NNW             12.5                                1     12.5     3.0

  CALM                                                 0      0.0

COL. TOTALS  37.5  37.5  25.0                          8              3.9
```

EB05607N - Frequency tables of pilot ballon data winds aloft (speed and direction), inversion base heights, and mixing depths

EB056070 - Wind speed and direction retrieval and summary for input to AIR00004.

Examples of the printed reports from Jobs M and N are presented as Figures 12 through 15. An understanding of the acoustic radar and pilot balloon programs and the parameters derived therefrom is beyond the scope of this report. These programs are described and the data summaries utilized, in the several MAPS publications on Meteorology and Modeling.

V. OTHER SUBSYSTEMS

The main data bank system and the PFT system described in this report, along with the ARMS modeling system, have been designed so as to meet most of the needs listed in Table 1. Some aspects of the data bank and ARMS system remain to be accomplished, as is discussed in the next Section. However, the high-priority needs have been met adequately for the immediate present.

However, because of funding and time constraints, three other subsystems of the ultimate comprehensive system with lower priority have not been significantly developed during MAPS' first two years. These are the emissions data, enforcement data, and technical library portions of the system, in order of their currently judged priority.

The emissions data system was planned to be a major enhancement of the present capability, which is a simple EPA-developed system. Required are expansion to incorporate the major new emission inventory conducted by MAPS plus the modification of a number of features found to be inadequate in the Bureau staff's experience with the system. Some initial efforts were undertaken under MAPS but resources did not permit the major effort required. Since the MAPS emission inventory was significantly delayed and hence unavailable for computerization, this was not an immediate problem, but the emissions data system remains the most important unmet requirement.

The proposed sub-system for managing the enforcement data was not undertaken, even in a preliminary manner. Most of the permitting, inspection, and enforcement action procedures of the Bureau have been in the process of being modified through most of the last two years, as the result of the consideration and adoption of significantly-revised regulations by the State Board of Health and Environmental Sciences. Consequently, this portion of the system was given a low priority, and is only now becoming stabilized enough to consider computerization.

The automation of the Bureau library was not accomplished during the first two years, again because of its priority compared to other efforts. The Bureau maintains a sizable volume of technical literature, of the detailed reference type that is used relatively infrequently, but usually with some urgency at each use. The material is cataloged, and the catalog is maintained on the computer for listing purposes. However, the accession of new material is handled by hand and the catalog is generally not current. It is envisioned that the system should be expanded to include a computerized subject index and improved accession capabilities. This can probably be accomplished by adopting and modifying an existing system from some similar agency, but at present only preliminary exploratory steps are being pursued.

VI. FURTHER WORK

As noted earlier, the systems design work on the data system was not thoroughly completed, particularly with respect to the modification of the EPA AQDHS-II system to local requirements. Further work is warranted and many smaller items may be done with existing AQB staff; this section presents a brief list of possible further modifications. The items discussed here are not necessarily the result of extensive systems analysis, so they must be seen as items to be considered, not as changes that have already been judged worthwhile. Nor is the list here at all exhaustive; it is merely the items that have appeared most prominently in experience to date.

Several small items of possible improvement to the system are categorized as "finishing up" low-priority items that were left incomplete or which have only appeared with experience.

Company data. The details of logistical arrangements and required conversions remain to be completed before the air quality and meteorological data gathered by private industries can be routinely incorporated into the data bank.

Rearrange Production Jobs. Several of the large number of production jobs remain in the same form in which they were originally installed, usually operating a single program, so that the Data Controller may need to execute two or even three steps to accomplish a particular task. As experience accumulates, the patterns in which programs are linked into production jobs whould be reviewed, and new jobs developed as required. An initial such review is probably warranted at present.

Combined Data Entry and Retrieval. As a particularly sizable example of the previous item, consideration should be given to developing new more complex procedures, or possibly new "driver" programs, which could combine most of the data entry jobs into one routine, and may retrievals into another. For example, the difference between Jobs EB05607A and B is a matter of whether or not to run one intermediate step, the SAROAD-AQDHS conversion. In a mature system, the Form Code on the coding sheets could easily make this distinction, minimizing the complexity humans must face in dealing with the system. Similarly, the proper routine retrieval job must be selected by the user according to the pollutant of interest - wind direction summarized like TSP is useless. But the computer can make this choice from the parameter code.

Modify master file usage. At present, the system is designed to maintain at least one, and up to two, years' data on the "current" master file before archiving a full year's data over to the "historical" master file. Since the master file structure is sequential; this means that every update run, every retrieval run, must read through most of the entire file; this is wasteful and costly. One possible alternative is to use the technique of file indexing, i.e. giving the computer a directory to the file so it can find its place more economically. This would require programming and would involve changing the file structure. Another alternative to partially improve things would involve the way in which the two files are maintained; the data could be batched over to the historical file more frequently, i.e. quarterly or even monthly when a batch of data is complete and validated. This would minimize the size of the "current" file, but would not help the retrieval side.

Another category of refinements involve the human system outside the data bank, and its interface with the computer. Hopefully, the existence of the DPC position will improve some of these matters.

Change master file useage. The second possibility in the previous item is primarily in this category, involving the way the system is used rather than the system itself.

Monitor input data flow status. Some system of keeping track of the status of various pieces of input data would be desirable. One possibility is to run the edit/update job with the LIST option turned on, to get a paper record of transactions.

Batch data for input. If the flow of incoming data were organized into some sort of logical batches, such as all data for one week, the task of monitoring the flow would be simpler.

A final category of further developments involves giving the system completely new retrieval capabilities. Of the many that are conceivable, two would seem to be the most useful by experience to date.

Data Status Inventory. Monitoring the status of data entry into the data bank is a fairly detailed chore, the type a computer is well-suited to. If the structure of the monitoring network were "known" to the computer, in terms of sites and pollutants to be expected, it could easily monitor whether all the data was present or not. Given the difficulties experienced to date, it would probably be worth at least a modest programming effort to do this. Such a program could also assist in keeping track of the status of instruments and sites in the network.

Multiple pollutant retrieval. One important capability the system does not currently have is the ability to output in one record the various parameters measured at the same time and site. Any multivariate statistical procedure, ranging from a simple correlation of TSP with respirable particulates to an elaborate factor analysis among various heavy metals, requires data in this form. At present, the data bank can only output the one-parameter-per-record format of the master file (or its SAROAD conversion), leaving the user write a program to re-format it. A flexible, use-oriented retrieval routine would be relatively simple and quite useful.

APPENDIX A

Data Coding Forms used in Pulmonary Function Testing (PFT) Program

Form 1 - Children General Background

Form 2 - Children's Monthly Report

Form 3 - Adult General Background

Form 4 - Adult Data at Time of test

Form 5 - Adult Daily Report

MAPS Form 1

MONTANA AIR POLLUTION STUDY
INFORMATION TO BE OBTAINED ON SCHOOL CHILDREN
GENERAL BACKGROUND

I.D. # (2-5) ________ Name ____________________

Last (6-17) First (18-25) MI (26)

Address ____________________ City __________

Phone # __________ Zip __________

School (27-28) ____________________ Grade (29) ________

Date of Birth (30-35) ______/______/______
Month / Day / Year

Sex (36) Male ______0 Female ______1

Race (37) ______________

How long has this child lived in this city? (38-40) ______ yrs ______ mos

How long at this address? (41-43) ______ yrs ______ mos

Did the child's previous home have more or less air pollution than this city? (44) What city was it? ______________

More air pollution ______0
Less air pollution ______1
About the same ______2
Have not moved ______3

Does this child live within one block of a busy street? (45)

No ______0 Yes ______1

HOME:

Which of the following fuels are used to heat this child's home? (46-48) If more than one fuel, enter X for primary fuel (46), XX for secondary (47), or XXX for third fuel (48).

Oil	1	☐	Wood	4	☐
Gas	2	☐	Electricity	5	☐
Coal	3	☐	Other, specify	6	______________

By what heating method? Enter X for primary (49), XX for secondary (50).

Forced Air	1	☐	Space Heater	3	☐
Fireplace	2	☐	Other, specify		______________

_2 _3 _4 _5

______ 6-17

______ 18-25 _26

_27 _28 _29

_30 _31 _32 _33 _34 _35

_36

_37

_38 _39 _40

_41 _42 _43

_44

_45

_46 _47 _48

_49

_50

What fuel is used for cooking? (51-52)

51 52

Oil ☐ 1
Gas ☐ 2
Coal ☐ 4
Wood ☐ 8
Electricity ☐ 16
Other, specify ____________

Does this child live in a house, apartment, mobile home or other?(53)

53

House ☐ 1
Apartment ☐ 2
Mobile home ☐ 4
Other, specify ____________

Is this child's home air conditioned? (54)

54

No ☐ 0
Yes, partially ☐ 1
Yes, completely ☐ 2

Is the child's bedroom air conditioned? (55) No ____ 0 Yes ____ 1

55

Is there an electrostatic air cleaner? (56) No ____ 0 Yes ____ 1

56

CHILD'S HEALTH BACKGROUND

Has this child had any of the following illnesses?

	No (0)	Yes (1)		
Measles (57)				57
Bronchitis (58)				58
Pneumonia (59)				59
Croup (60)				60
Whooping cough (61)				61
Asthma (62)			If YES, began at age ____ Present now? ________	62 63 64 65
Hay Fever (66)			If YES, began at age ____ Present now? ________	66 67 68

69

In the past year has this child had a chest illness that kept him/her at home for three days or more? (70-71)

70 71

No ____ 0 If YES, how many times? ____________

Was a doctor seen for a severe chest illness or chest cold before the age of two years? (72-73)

72 73

No ____ 0 If YES, how many times? ____________

Was the child hospitalized for a severe chest illness or chest cold before the age of two years? (74-75) 74 75

No _____ 0 If YES, how many times? _______________

Is the child taking any medication at present? (76-77)
No _____ 0 Yes _____ 1 If YES, what? _______________ 76 77

WE ALSO NEED SOME INFORMATION ABOUT THE ADULT HOUSEHOLD MEMBERS

A. Male Head of Household

Is a male head of household present in the home? (78)

No _____ 0 Yes _____ 1 78

IF NO, GO TO B

What is the highest grade of school he has completed? (79) _____ 79

What is his present job title? (80-81) _______________ 80 81

Has he ever smoked? (82) No _____ 0 Yes _____ 1
Does he now smoke? (83) No _____ 0 Yes _____ 1 82 83
If YES, how many:

cigarettes per day (84-85) _________ 84 85

cigars per day (86-87) _________ 86 87

pipes per day (88-89) _________ 88 89

B. Has a doctor ever said this child's natural father had:

bronchitis or emphysema? (90) No _____ 0 Yes _____ 1 90

asthma? (91) No _____ 0 Yes _____ 1 91

C. Female head of household

Is a female head of household present in the home? (92)

No _____ 0 Yes _____ 1 92

IF NO, GO TO D

What is the highest grade of school she has completed? (93) _____ 93

What is her present job title? (94-95) _______________ 94 95

Has she ever smoked? (96) No ____ 0 Yes ____ 1 — 96

Does she now smoke? (97) No ____ 0 Yes ____ 1 — 97

If YES, how many:

cigarettes per day (98-99) ____ — 98 99

cigars per day (100) ____ — 100

pipes per day (101) ____ — 101

D. Has a doctor ever said this child's natural mother had:

bronchitis or emphysema? (102) No ____ 0 Yes ____ 1 — 102

asthma? (103) No ____ 0 Yes ____ 1 — 103

E. Other persons (not including male or female head of household)

How many other persons in the household smoke tobacco? (104)____ — 104

Have there been any birth defects in your immediate family?(105) — 105

No ____ 0 Yes ____ 1

If YES, among blood relatives? (106) No ____ 0 Yes ____ 1 — 106

Have there been any diagnosed cases of cancer in your immediate family? (107) — 107

No ____ 0 Yes ____ 1

If YES, among blood relatives? (108)No ____ 0 Yes ___ 1 — 108

Date questionnaire completed (109-112) ________________
Month / Year — 109 110 111 112

Frequency code ________________ (113) — 113

Update code ________________ (114) — 114

MAPS Form 2

MONTANA AIR POLLUTION STUDY
SCHOOL CHILDREN'S MONTHLY REPORT

Name ____________________ ID # (2-5) ________ 2 3 4 5

Date of Test (6-11) ______/____/______ 6 7 8 9 10 11
Month / Day / Year

blank

Test Period (12-15) ________/______ Season (16) ________ 12 13 14 15 16
Month / Year

School (17-18) ____________________ Grade (19) ________ 17 18 19

* * * * * * * * * * * * * * * *

Height (20-22) ____________ centimeters 20 21 22

Weight (23-24) ____________ kilograms 23 24

Were you sick in the last week? (25) No ___ 0 Yes ___ 25

If YES, how were you sick? (for example, was it a cold, headache, runny nose, stomach ache, or other?)

____

(If flu, was it respiratory or stomach flu?)

Are you sick today? (26) No ____ 0 Yes ____ 26

If YES, how are you sick? ____________________

* * * * * * * * * * * * * * * *

Cause of absence (27) ____________________ 27

Technician code (28) ________ 28

Equipment code (29-39) ___________ 29 30

Temperature of the room (31-32) _________ Centigrade 31 32

Have you ever smoked a cigarette? A few puffs? 5 cigarettes or more? (33) 33

No, not even a few puffs _____ 0
Only a few puffs _____ 1
Five or more cigarettes _____ 2

If more than five, fill out smoking questionnaire.

Have you ever smoked anything other than cigarettes? (34) 34

No ______ 0 Yes _____

10/20/78

Department of Health and Environmental Sciences
STATE OF MONTANA HELENA, MONTANA 59601

A C Knight M D F C C P
Director

MAPS Form 3

MONTANA AIR POLLUTION STUDY

INFORMATION TO BE OBTAINED ON ADULTS
GENERAL BACKGROUND

Name ______________________________ ID# (25) __________
Last (6-17) First (18-25) MI (26)

2 3 4 5

Address ____

6-17

City ______________ ZIP __________ Phone ______________

May we phone you at work? Yes ___ No ___ Phone ______________

18-25

Birthdate (27-32) ____/____/____
Month / Day / Year

26

27 28 29 30 31 32

Sex (33): Male _____ 0 Female _______ 1

33

Number of years resident in this town? (34-35) ________

34 35

Number of years in your present part of town? (36-37) ________

36 37

Race (38): Indian ___ Black ___ Oriental ___ Caucasian ___
Mexican/Spanish American ___ Other __________

38

Work History (39): Pleast start with present job, go back 20 years if possible)

Length of Employment From	To	Company and City	Job Title	Check if exposed to unusual dust, fumes

39

At or near your job or school, are there any unusual sources of dust or fumes? (40) No ___ 0 Yes ___ 1

40

A. If Yes, does the dust or fumes tend to make your lung problems worse? No ___ 0 Yes ___ 2

B. What is the source of the dust or fumes? ______________

EEO/AFFIRMATIVE ACTION AGENCY

(41) In or near your home, are there unusual sources of dust or fumes? No ___ 0 Yes ___ 1 41

A. If Yes, does the dust or fumes tend to make your lung problems worse? No ___ 0 Yes ___ 2

B. What is the source of the dust or fumes? ______________

CURRENT HEALTH

("Usually" means "as much as 4-6 times a day for 4 days of the week")

COUGH (42-43) 42 43

A. Do you usually have a cough? No ___ 0 Yes ___ 1

B. Do you usually cough on getting up, or first thing in the morning?

In winter: No ___ 0 Yes ___ 2

In summer: No ___ 0 Yes ___ 4

C. Do you go on coughing during the day or at night?

In winter: No ___ 0 Yes ___ 8

In summer: No ___ 0 Yes ___ 16

If YES to any of the above questions about cough: (44-45) 44 45

D. Do you cough like this on most days for as much as 3 months at a time?

No ___ 0 Yes ___ 1

E. How long have you had this cough?

Less than 3 years ___ 0

3 years or more ___ 2

F. Is your cough worse when the weather is foggy or damp?

No ___ 0 Yes ___ 4

G. Is your cough worse when the weather is cold?

No ___ 0 Yes ___ 8

H. Is your cough worse when the weather is hot?

No ___ 0 Yes ___ 16

I. Is your cough worse when air pollution is bad?

No ___ 0 Yes ___ 32

PHLEGM (46-47)

46 47

A. Do you usually bring up phlegm (thick mucous) from your chest (not from the back of your nose)?

No ___ 0 Yes ___ 1

B. How long have you had this phlegm?

Less than 3 years ___ 0

3 years or more ___ 2

C. Do you get bouts of (increased) cough and phlegm lasting for at least three weeks each winter?

No ___ 0

Yes, last three winters only ___ 4

Yes, more than 3 winters ___ 8

If YES, to any of the above questions about phlegm: (48-49)

48 49

D. Is your phlegm increased when the weather is foggy or damp?

No ___ 0 Yes ___ 1

E. Is your phlegm increased when the weather is cold?

No ___ 0 Yes ___ 2

F. Is your phlegm increased when the weather is hot?

No ___ 0 Yes ___ 4

G. Is your phlegm increased when air pollution is bad?

No ___ 0 Yes ___ 8

WHEEZING (50-51)

50 51

A. Does your chest ever sound wheezy or whistling?

No ___ 0 Yes ___ 1

B. If NO, even when you have a cold?

No ___ 0 Yes ___ 2

C. If YES,

Only with colds? ___ 4

Occasionally apart from colds? ___ 8

Most days or nights? ___ 16

D. If YES to most days or nights, has this been present for the past three years or more?

No ___ 0 Yes ___ 32

WHEEZING Continued (52-53)

52 53

E. Have you ever had an attack of wheezing that has made you feel short of breath?

No ___ 0 Yes ___ 1

F. If YES, have you had 2 or more such episodes?

No ___ 0 Yes ___ 2

G. Have you ever required medicine or treatment for the attack(s)?

No ___ 0 Yes ___ 4

If YES to any of the above questions on wheezing: (54-55)

54 55

H. Is your wheezing worse when the weather is foggy or damp?

No ___ 0 Yes ___ 1

I. Is your wheezing worse when the weather is cold?

No ___ 0 Yes ___ 2

J. Is your wheezing worse when the weather is hot?

No ___ 0 Yes ___ 4

K. Is your wheezing worse when air pollution is bad?

No ___ 0 Yes ___ 8

BREATHLESSNESS

A. Are you disabled from walking by any condition other than heart or lung disease? (56)

56

No ___ 0 Yes ___ 1

If YES, describe and do not answer the following set of questions: ______________________________

If NO to the above question: (57-58)

57 58

(B-G)

B. Are you troubled by shortness of breath? No ___ 0 Yes ___ 1

C. If NO, not even when hurrying on the level or walking up a slight hill?

No ___ 0 Yes ___ 2

D. If YES, do you have to walk slower than people of your age on the level because of breathlessness?

No ___ 0 Yes ___ 4

BREATHLESSNESS (continued)

E. IF YES, do you ever have to stop for breath when walking at your own pace on the level?

No ____ 0 Yes ____ 8

F. If YES, do you have to stop for breath after walking about 100 yards (or after a few minutes) on the level?

No ____ 0 Yes ____ 16

G. If YES, are you too breathless to leave the house, or breathless on dressing or undressing?

No ____ 0 Yes ____ 32

H. Have you ever had a doctor tell you (diagnose) what your breathlessness was due to? (59-60) No ____ 0 Yes ____ 1

If YES, what was it due to? Heart problems ____ 2
lung problems ___ 4 Other problems ___8, What? __________

__ __
59 60

If YES to any of the above questions about breathlessness: (61-62)

__ __
61 62

I. Have these symptoms been present for at least the past 2 winters?

No ____ 0 Yes ____ 1

J. Is your breathlessness worse when the weather is foggy and damp?

No ____ 0 Yes ____ 2

K. Is your breathlessness worse when the weather is cold?

No ____ 0 Yes ____ 4

L. Is your breathlessness worse when the weather is hot?

No ____ 0 Yes ____ 8

M. Is your breathlessness worse when air pollution is bad?

No ____ 0 Yes ____ 16

COLDS (63)

__
63

A. If you get a cold, does it usually go to your chest?

No ____ 0 Yes ____ 1

PAST CHEST ILLNESSES

During the past 3 years, have you had any chest illness that has kept you off work, indoors at home, or in bed? No ___ 0 Yes ___ 1 64

If YES, what were the details of each illness? (If more than six spaces are needed, please write on an additional sheet of paper and check here _____.)

When? (year)	Lasted one week or more No	Yes	Had increased phlegm No	Yes	Hospitalized No	Yes	Diagnosis:
							. . . .
							. . . .
							. . . .
							. . . .
							. . . .
							. . . .
TOTALS (65-66)	(67-68)		(69-70)		(71)		Diagnosis 72 73

65 66 67 68

69 70 71

72 73

A. Has a doctor ever said you had: (74-75)

	No	Yes		No	Yes
Chronic Bronchitis	___ 0	___ 1	Sinus trouble	___ 0	___ 8
Emphysema	___ 0	___ 2	Pulmonary TB	___ 0	___ 16
Lung cancer	___ 0	___ 4	Hay Fever	___ 0	___ 32

74 75

B. Has a doctor ever said that you had asthma or bronchial asthma? (76)

No ___ 0 Yes, at present ___ 1 Yes, in past (not now) ___ 2 76

C. Have you ever had:

Other chest illness (77) No ___ 0 Yes ___ 1 What? ________________ 77

Chest operation? (78) No ___ 0 Yes ___ 1 What? ________________ 78

Chest injury? (79) No ___ 0 Yes ___ 1 What? ________________ 79

PAST CHEST ILLNESS (Continued)

D. Has a doctor ever told you that you had heart trouble? (80) 80

No ___ 0 Yes ___ 1

If YES to the above question:

E. How many times have you seen a doctor for heart trouble in the last ten years? (81-82) __________ 81 82

F. How many times were you hospitalized for heart trouble for a day or more? (83-84) __________ 83 84

G. Has a doctor ever told you that your blood pressure was high? (85) 85

No ___ 0 Yes ___ 1

TOBACCO SMOKING (86)

A. Have you ever smoked? No ___ 0 Yes ___ 1 86

B. Do you now smoke? (as of one month ago) No ___ 0 Yes ___ 2

C. Are you willing to not smoke for the duration of this study (2 years)?

No ___ 0 Yes ___ 4

Amount Smoked

	Packs of (20) Cigarettes/Week			Hand-rolled Tobacco oz/wk		
	a Weekly Amount	b Years Duration	(a)x(b)	c Weekly Amount	d Years Duration	(c)x(d)
Present Pattern						
Past Periods ↓						
		(87-89) Total			(90-92) Total	

87 88 89

90 91 92

	Pipe Tobacco oz/wk			Cigars/wk		
	e Weekly Amount	f Years Duration	(e)x(f)	g Weekly Amount	h Years Duration	(g)x(h)
Present Pattern						
Past Periods						
	(93-95) Total			(96-98) Total		

93 94 95

96 97 98

D. Do you smoke filter-tip cigarettes currently? (for the past month at least) (99)

Never ___ 0; Less than ½ time ___ 1; over ½ time ___ 2;

Always ___ 4

99

E. How long have you been using filter-tips? (100-101)_____ years

100 101

	Never Smoked	Not At All	Slightly	Moderately	Deeply	
Do/did you inhale the cigarette smoke?	___ 0	___ 1	___ 2	___ 3	___ 4	102
Do/did you inhale the pipe/cigar smoke?	___ 0	___ 1	___ 2	___ 3	___ 4	103

Do you work daily with people who smoke near you? No ___ 0 Yes ___ 1

104

ALLERGIES (105-106)

105 106

For each of the following, if the response is "Yes", was it confirmed by a doctor?

			Confirmed by doctor	
Have you ever had an allergic reaction to:	No	Yes	No	Yes
food or medicine (ingested?)	___ 0	___ 1	___ 0	___ 2
pollen, dust (inhaled)?	___ 0	___ 4	___ 0	___ 8
detergents, metals (skin contact)?	___ 0	___ 16	___ 0	___ 32

TOBACCO EXPOSURE

In your home for each person present list:

Smokers in home	# of cigarettes/day	# cigars/day	# pipes/day
Person #1			
Person #2			
Person #3			
Person #4			
Person #5			
Person #6			
Total	(107-109)	(110-112)	(113-115)

107 108 109

110 111 112

113 114 115

A. How many hours per day are you on a job or at school away from home? (116-117) ______

116 117

B. How many hours per day on your job or at school are you usually exposed to:

No tobacco smoke (118-119) ______ hours/day

Little tobacco smoke (120-121) ______ hours/day

Moderate tobacco smoke (122-123) ______ hours/day

Heavy tobacco smoke (124-125) ______ hours/day

118 119

120 121

122 123

124 125

A. Which of the following is used to heat your home? (126-127)

Oil ___ 1; Gas ___ 2; Coal ___ 4; Wood ___ 8;

Electricity ___ 16; Other, Specify (32): ______________

126 127

B. By what heating method? (128-129)

Hot air ___ 1; Hot water ___ 2; Steam ___ 4; Fireplace ___ 8;

Space heater ___ 16; Other, specify (32): ______________

128 129

C. What fuel is used for cooking? (130-131)

Oil ___ 1; Gas ___ 2; Coal ___ 3; Wood ___ 4;

Electricity ___ 5; Other, specify (6) ______________

130 131

D. Is your home air conditioned? (132-133) No ___ 0

Yes, partially ____ 1 Yes, completely ____ 2

If partially, is the living room? No ___ 0 Yes ___ 4

Is your bedroom? No ___ 0 Yes ___ 8

Do you have an electrostatic air cleaner? No ___ 0 Yes ___ 16

___ ___
132 133

Census enumeration district (134-136) ____________

___ ___ ___
134 135 136

Update Code (137) ____________

___
137

I authorize Dr. ____________________ to release medical information regarding my lung problem to Dr. Kit Johnson for the State Department of Health and Environmental Sciences' Air Pollution and Health Study. This information will be kept in strictest confidence and I will not be identified for public record without further written consent.

Signature ____________________

Witness ____________________ Date ____________

I authorize Dr. Kit Johnson to release medical information obtained during my pulmonary function testing study to Dr. ____________, my usual physician.

Signature ____________________

Witness ____________________ Date ____________

MONTANA AIR POLLUTION STUDY

ADULT DATA TO BE OBTAINED AT THE TIME OF PULMONARY FUNCTION TEST

Name ______________________ I.D. #(2-5) __________

2 3 4 5

Date of Test (6-11) ______/______/______ Season (16) __________
Month Day Year

6 7 8 9 10 11

Test Period (12-15) ______/______
Month Year

12 13 14 15 16

Height (17-19) __________

17 18 19

Weight (20-22) __________

20 21 22

Time of Pulmonary Function Test (23-24) __________

23 24

Elapsed time in room before pulmonary function test (25-26) __________ minutes

25 26

Today's Medication:

MEDICATION	TIME OF DOSES	ELAPSED TIME	DRUG #
		(27-28)	(29-31)
		(32-33)	(34-36)
		(37-38)	(39-41)
		(42-43)	(44-46)
		(47-48)	(49-51)
		(52-53)	(54-56)

27 28 29 30 31

32 33 34 35 36

37 38 39 40 41

42 43 44 45 46

47 48 49 50 51

52 53 54 55 56

Technician code (57) __________

57

Equipment Code (58-59) __________

58 59

Temperature of the room (60-61) ____ ____

60 61

8/22/78

MONTANA AIR POLLUTION STUDY

ADULT DAILY REPORT

Please complete the information below for each day during the week preceding your pulmonary function testing:

Name ________________________ ID# __________ 2 3 4 5

Report for ____________, ______ / ______ / ______ 6 7 8 9 10 1
(day of the week) month day year (6-11)

Place an X in the appropriate box:

	Much more than usual	More than usual	Usual amount	Less than usual	Much less than usual	
Shortness of breath (12)						12
Cough (13)						13
Wheezing (14)						14
Phlegm (15)						15
Self-treatment for lung prob. (16)						16
Other illness: (17) ____________						17
Fever (18)			(none)			18

Was there any significant difference in your activity today, such as being out of town or hospitalized? (19) No ____ 0 Yes ____ 1 19
If yes, what? ____

Did you perform at your usual activity level today? (20) No ___0 Yes___1 20

A. If NO, how many hours were you unable to perform usual activitiy because of lung problems? (21-22) __________ 21 22

B. If NO, how many hours were you unable to perform usual activity because of other problems?(23-24) __________ 23 24

Did you seek medical help today? (25) No ___ 0 Yes ___ 1 25
If YES, what kind? ________________________________

Did you smoke today? (26-27) No ___ 0 Yes ___ 1 26 27
If YES, what did you smoke? ____________________________

Were you exposed to any unusual dust or fumes today? (28)No___0 Yes___1 28
If YES, what? ____

How many hours did you spend outdoors today? (29-30) ________ hours 29 30

8/22/78

APPENDIX B

Air Quality Bureau Data Flow

CONTINUOUS (HOURLY) AIR QUALITY DATA FLOW PARAMETERS:

42401 (except method code 11), 11203, 42101, 42269, 42601, 42602 (except method code 84), 42603, 43101, 43102, 43201, 44201.

1. Field monitoring - data recorded on strip charts.
2. Operator performs visual integration of all 1 hour values on strip charts and records on SAROAD forms.
3. Operator completes forms, sends charts and forms to the Bureau weekly.
4. Data received and logged in at AQB by the Data Processing Controller (DPC).
5. Both strip charts and SAROAD forms sent to the Statistical Technician (ST) for data verification and quality assurance checking.
6. SAROAD forms returned to DPC, batched, logged and submitted to Data Entry.
7. Upon return from Data Entry, batch is logged and computer job is submitted to AQDHS by DPC.
8. Computer job returned, logged and data printout (including error lists) together with SAROAD forms are sent to ST for quality assurance checking and error resolution.
9. Forms containing errors are corrected and resubmitted at step 6, good forms are filed. Data update lists are sent to supervisor for filing.
10. Monthly, the computer job is submitted and the monthly data report is sent to supervisor for data analysis.

MEMBRANE, HI-VOL, METALS, DICHOTOMOUS (24 HOUR) DATA FLOW PARAMETERS:

11101, 121XX (WHERE XX = ANY 2 DIGIT NUMBER).

1. Filters are weighed, with weights recorded in the lab book, and filters sent to DPC.
2. DPC logs in filters and distributes to field operators.
3. Operators collect samples and teturn to AQB as soon as completed.
4. Filters logged in by DPC, sent to ST.
5. ST calculates flow rate, records on filter holder, fills out top of SAROAD forms, batches them and returns them to DPC.
6. Samples and SAROAD forms logged in by DPC and sent to the lab.
7. Lab performs analysis.
   - filters weighed and weights recorded on filter holder
   - concentration calculated and recorded on filter holder
   - filters cut for analysis for metals

   Lab fills out the rest of the SAROAD forms and records analysis results, sending SAROAD forms to AQB.
8. SAROAD forms logged in by DPC and an occasional batch is sent to supervisor or the ST for quality assurance check.
9. SAROAD forms returned to DPC, batched, logged and submitted to Data Entry.
10. Upon return from Data Entry, batch is logged and AQDHS computer job is sumbitted.
11. Computer job returned, logged and data printout (including error lists), together with SAROAD forms, sent to the ST for quality assurance check and/or error resolution.
12. Forms containing errors are corrected and re-submitted at step 9; good forms are filed. Data update lists are sent to supervisor for filing.
13. Monthly, the computer job is submitted and the monthly data report is sent to supervisor for data analysis.

CONTINUOUS METEOROLOGICAL DATA FLOW (WIND, WIND RELATED AND NON-WIND)

PARAMETERS: 63301, 11203, 61101-61110, 62101-62201, 64101.

1. Field monitoring - data recorded on strip charts.

2a. Operator performs visual integration of all 1 hour values on strip charts and records on SAROAD forms.

2b. In a few cases (sites) an exception to the normal flow occurs at this step: the operator does not read the charts or complete the SAROAD forms.

3a. Operator completes forms, sends charts and forms to AQB on weekly basis.

3b. Charts only are sent in exception cases.

4. Data received and logged in at AQB by DPC.

5a. Strip charts and SAROAD forms sent to ST for quality assurance check.

5b. Strip charts sent to ST who interprets them and codes SAROAD forms.

6. SAROAD forms returned to DPC, batched, logged in and submitted to Data Entry.

7. Upon return from Data Entry, batch is logged in and computer job submitted to AQDHS.

8. Computer job returned logged and data printout (including error lists), together with SAROAD forms, sent to ST for quality assurance check and error resolution.

9. Forms containing errors are corrected and re-submitted at step 4 (step 5b is bypassed), and good forms are filed.

10. Monthly, the computer jobs to run the various meteorological analysis programs are logged and submitted.

11. The meteorological reports are sent to supervisor for data analysis and quality assurance checks.

UPPER AIR, RADAR, VOLZ METEOROLOGICAL DATA FLOW

PARAMETERS: 613010-61501, 63202-63214.

1. Field monitoring - upper air and Volz readings coded directly from instrument to forms by operator.
2. Operator sends upper air and Volz forms to AQB weekly.
3. Billings radar charts sent to meteorologist in Missoula for interpretation and coding, then to AQB.
4. Radar charts interpreted, forms coded and sent to AQB monthly.
5. Data received and logged in by DPC.
6. Forms sent to Helena meteorologist for data verification.
7. Forms returned to DPC, logged, batched and submitted to Data Entry.
8. Upon return from Data Entry, batch is logged and data is input to various meteorological programs via computer jobs.
9. Computer jobs returned, logged and summary reports sent to Helena meteorologist for quality assurance check and error resolution.
10. Forms containing errors are corrected and re-submitted at step 5.
11. After error correction, data is logged, submitted to AQDHS via computer job by DPC.
12. Computer job returned, logged, and data printout (including error lists), sent to Helena meteorologist for error resolution and/or filing.

COMPANY COLLECTED AIR QUALITY AND METEOROLOGICAL DATA (NWS MET, MHD RADAR AND CONTINUOUS MET, ANACONDA CONTINUOUS MET. AND AIR QUALITY)

PARAMETERS: 61101, 61102, 62101, 62103, 62201, 66101-66302: all method 20

1. Data received by AQB in computer input form (cards or tape), logged in by DPC.
2. DPC submits appropriate computer jobs to convert data to AQDHS format.
3. Computer job returned and logged in by DPC.
4. DPC submits converted data to AQDHS via computer job.
5. Computer job returned, logged and data printout (including error lists) sent to supervisor for quality assurance check.
6. Data is printed on normal monthly reports and sent to supervisor for data analysis.

APPENDIX C

Standard SAROAD/AQDHS Codes

Table C-1	Agency Codes
C-2	Project Type Codes
C-3	Time Interval Codes
C-4	Unit Codes

Table C-1

SAROAD Agency Codes

Code	Agency
A	EPA group responsible for atmospheric surveillance
B	EPA group responsible for meteorological activity
C	EPA group responsible for effects research
D	EPA group responsible for atmospheric research
E	EPA group responsible for abatement activity
F	State agency
G	County agency
H	City agency
I	District agency
J	Private
K	Institution (university, college, etc.)
L	Military
M	International agency
N	Other Federal nonmilitary agencies
O-Y	Open for future expansion
Z	Other

Table C-2

SAROAD Project Codes

Long-term surveillance

Code	Project
01	Population-oriented surveillance
02	Source-oriented ambient surveillance
03	Background surveillance

Short-term Surveillance

Code	Project
04	Complaint investigation
05	Special studies
06	Episode monitoring

Table C-3

SAROAD Time Interval Codes

Format 1 Transaction

Code	Interval
1	1 hour
2	2 hours
3	3 hours
4	4 hours
5	6 hours
6	8 hours
7	12 hours

Format 2 and 3 Transactions

Code	Interval
8	1 day
9	1 week
A	1 month
B	1 quarter
C	Composite data (Format 2 only)

Table C-4

SAROAD Unit Codes

Code	Units
01	micrograms/cubic meter (25° C, 1013 millibars)
02	micrograms/cubic meter (0° C, 1013 millibars)
03	nanograms/cubic meter (25° C, 1013 millibars)
04	nanograms/cubic meter (0° C, 1013 millibars)
05	milligrams/cubic meter (25° C, 1013 millibars)
06	milligrams/cubic meter (0° C, 1013 millibars)
07	parts per million (volume/volume)
08	parts per billion (volume/volume)
09	COHS/1000 linear feet
10	RUDS/10,000 linear feet
11	meters/second
12	miles/hour
13	knots
14	degrees
20	microns
30	picocuries/cubic meter
31	microcuries/cubic meter
32	picocuries/square meter
33	microcuries/square meter
34	picocuries/cubic centimeter
35	picocuries/gram
50	number of threshold levels
70	milligrams F/100 square centimeters-day
80	milligrams SO_3/100 square centimeters-day
81	micrograms SO_2/square meter-day
90	tons/square mile-month[a]
91	milligrams/square centimeter-month[a]
92	micrograms/cubic meter-month[a]
98	milligrams SO_4^{2-}/square centimeters-30 days
99	milligrams/square centimeters-30 days

[a] On a calendar-month basis.

APPENDIX D

SAROAD Coding Forms

STATE OF MONTANA
DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
AIR QUALITY BUREAU

Date Received: ____________________

Analyst: ____________________

Date Completed: ____________________

	2	7
1	2	3

HV Mem. Dichot.

Parameter	Parameter	Parameter	Parameter
23 24 25 26 27	37 38 39 40 41	51 52 53 54 55	65 66 67 68 69
Method Units DP	Method Units DP	Method Units DP	Method Units DP
28 29 30 31 32	42 43 44 45 46	56 57 58 59 60	70 71 72 73 74

Area				Site			Agn	Pro		T	Year		Month		Day		St. Hr.																								
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		33	34	35	36		47	48	49	50		61	62	63	64		75	76	77	78		79	80

Form: 2179 Comments:

MONTANA STATE DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
Helena, Montana

State	Agency	Project	Time	Year	Period (month)	Number of Spls.	Comp Type	Spl. Time
2 3	11	12 13	14	15 16	17 18	19 20	21	22

2

Area Address

Collected By

Date Received Date Reported

Analyst

Comments or unusual activities:

Name PARAMETER Code	Name PARAMETER Code	Name PARAMETER Code	Name PARAMETER Code
23 24 25 26 27	37 38 39 40 41	51 52 53 54 55	65 66 67 68 69
Method Units DP	Method Units DP	Method Units DP	Method Units DP
28 29 30 31 32	42 43 44 45 46	56 57 58 59 60	70 71 72 73 74

Lab. No.	Sample No.	Location and Description	Date Out	Date In	Sampling Period	Area 4	5	6	7	Site 8	9	10	33	34	35	36	47	48	49	50	61	62	63	64	75	76	77	78

4 3 2 1 0 4 3 2 1 0 4 3 2 1 0 4 3 2 1 0

STATE DEPARTMENT OF HEALTH

AND ENVIRONMENTAL SCIENCES

HELENA, MONTANA

24-HOUR OR GREATER SAMPLING INTERVAL

2

1 **Agency**

City Name

Site Address

Project Time Interval

State	Area	Site
2 3 4	5 6 7	8 9 10

Agency	Pro. T.	Year	Month
11 12	13 14	15 16	17 18

	TSP	Org	As	Pb	Cd	Zn	SO$_4$*	
	Name PARAMETER Code	Name PARAMETER Code	Name PARAMETER Code	Name PARAMETER Code	Name PARAMETER Code	Name PARAMETER Code	Name PARAMETER Code	Name PARAMETER Code
	23 24 25 26 27	37 38 39 40 41	51 52 53 54 55	65 66 67 68 69	23 24 25 26 27	37 38 39 40 41	51 52 53 54 55	65 66 67 68 69
	Method Units DP	Method Units DP	Method Units DP	Method Units DP	Method Units DP	Method Units DP	Method Units DP	Method Units DP
	28 29 30 31 32	42 43 44 45 46	56 57 58 59 60	70 71 72 73 74	28 29 30 31 32	42 43 44 45 46	56 57 58 59 60	70 71 72 73 74

Collection Day 19 20	Lab. No.	Filter No.	Date Sample Logged	Operator	Total Volume Air (M3)	Unusual Circumstance *	Day 19 20	21 22	33 34 35 36	47 48 49 50	61 62 63 64	75 76 77 78	Day 19 20	33 34 35 36	47 48 49 50	61 62 63 64	75 76 77 78
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0 2							0 2						0 2				
0 3							0 3						0 3				
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2 9							2 9						2 9				
3 0							3 0						3 0				
3 1							3 1						3 1				
								DP →	4 3 2 1 0	4 3 2 1 0	4 3 2 1 0	4 3 2 1 0		4 3 2 1 0	4 3 2 1 0	4 3 2 1 0	4 3 2 1 0

Comments or unusual circumstances

* codes		
	0 = excess of 24 hr.	5 = dry
	1 = approx. 72°F	6 = clear
	2 = approx. 32°F	7 = hazy
	3 = rain	8 = calm
	4 = snow	9 = windy

BAQ

LESS THAN 24-HOUR SAMPLING INTERVAL

AIR QUALITY BUREAU

1 (1) ____________ Agency

____________ City Name

____________ Site Address

____________ Project

____________ Parameter observed

____________ Method

____________ Time interval of obs.

____________ Units of obs.

State 2 7 (2 3) Area ☐☐☐☐ (4 5 6 7) Site ☐☐☐ (8 9 10)

Agency ☐ (11) Project ☐☐ (12 13) Time ☐ (14) Year ☐☐ (15 16) Month ☐☐ (17 18)

Parameter code ☐☐☐☐☐ (23 24 25 26 27) Method ☐☐ (28 29) Units ☐☐ (30 31) DP ☐ (32)

Day 19 20	St Hr 21 22	Rdg 1 33 34 35 36	Rdg 2 37 38 39 40	Rdg 3 41 42 43 44	Rdg 4 45 46 47 48	Rdg 5 49 50 51 52	Rdg 6 53 54 55 56	Rdg 7 57 58 59 60	Rdg 8 61 62 63 64	Rdg 9 65 66 67 68	Rdg 10 69 70 71 72	Rdg 11 73 74 75 76	Rdg 12 77 78 79 80
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15	12												
16	00												

SAROAD Hourly Data Form.

LESS THAN 24-HOUR SAMPLING INTERVAL

AIR QUALITY BUREAU

1
1

Agency

City Name

Site Address

Parameter observed

Time interval of obs.

Method

Units of obs.

State: 2 7 (2 3)

Area: (4 5 6 7)

Site: (8 9 10)

Agency: (11)

Project: (12 13)

Time: (14)

Year: (15 16)

Month: (17 18)

Parameter code: (23 24 25 26 27)

Method: (28 29)

Units: (30 31)

DP: (32)

Day 19 20	St Hr 21 22	Project Rdg 1 33 34 35 36	Rdg 2 37 38 39 40	Rdg 3 41 42 43 44	Rdg 4 45 46 47 48	Rdg 5 49 50 51 52	Rdg 6 53 54 55 56	Rdg 7 57 58 59 60	Rdg 8 61 62 63 64	Rdg 9 65 66 67 68	Rdg 10 69 70 71 72	Rdg 11 73 74 75 76	Rdg 12 77 78 79 80
16	12												
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31	12												

SAROAD Hourly Data Form.

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